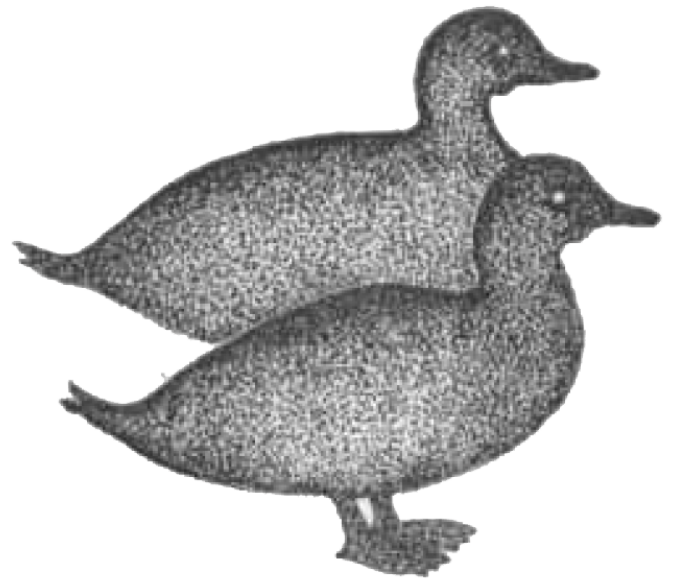


# Survey of the Avian Alimentary Tract



DWT Crompton & MC Nesheim

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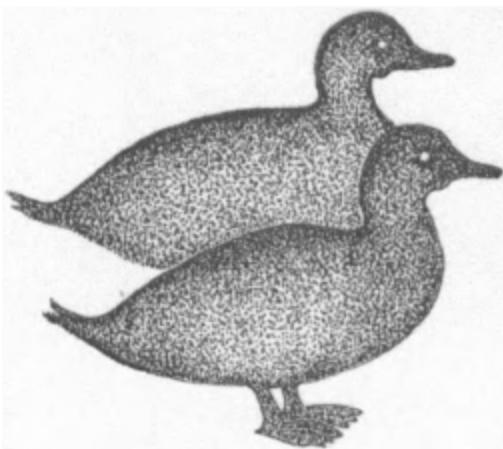
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# **Survey of the Avian Alimentary Tract**

DWT Crompton & MC Nesheim

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# Survey of the alimentary tract of birds

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Emeritus Professor of Nutrition, Cornell University

## **Preface**

Our collaboration began in 1965 with a mutual interest in digestion in birds and how helminths (parasitic worms) live in the avian alimentary tract. We studied host-parasite relations between ducks and *Polymorphus minutus* (Acanthocephala) but this system proved hard to maintain in the laboratory. We switched to the rat - *Moniliformis dubius* (Acanthocephala) relationship (Nesheim *et al*, 1977; Parshad *et al*, 1980). Later we published a review that showed we had diverted to help assess the impact of helminth infection on the digestive physiology, nutritional status and growth of children in developing countries (Crompton & Nesheim, 2002). Our work took us to Burma (now Myanmar), China, Dominican Republic, India, Kenya, Mexico, Nigeria, Panama, Sierra Leone and Venezuela. Visits were made to Egypt, Indonesia, Pakistan, Sri Lanka, Seychelles and Vietnam to encourage governments and agencies to bring helminth infections under control. We were part of the drive to convince Ministries of Health that the NTDs (Neglected Tropical Diseases) represent a global public health problem (WHO, 2010).

## **Purpose of the survey**

Now, some 40 years later, we have returned to the subject of our original collaboration. In the early 1970's we began an extensive project to document variation in the digestive system anatomy of a wide range of birds. We intended to relate the anatomical variations observed to the dietary practices of the bird. We were also seeking to address the question how do helminths thrive in the habitats to be found in the avian alimentary tract? *Psilostomum ondatrae* (Trematoda) lives in the proventriculus of pigeons (Beaver, 1939), *Diphyllbothrium sebago* (Cestoda) in the mid small intestine of gulls (Meyer & Vik, 1963), *Dispharynx nasuta* (Nematoda) in the crop of partridges (Madsen, 1952), *Heterakis gallinarum* (Nematoda) in the caeca of fowl (Roberts, 1937), and *Polymorphus minutus* (Acanthocephala) in the posterior small intestine of ducks (Crompton & Harrison, 1965). What features define the habitats

occupied by these helminths in birds and by others in other vertebrate hosts (Crompton, 1973)? As indicated, our research took a different direction in the mid 1970's so we never completed the project we had originally envisioned. We did, however, have a collection of drawings of the alimentary tract of a large number of individual birds. Since the anatomy of higher vertebrates is unlikely to have changed much during this time under natural conditions we hope that observations made during this survey will still be relevant and of interest. We want to make these drawings accessible to future investigators exploring aspects of avian anatomy and digestion.

## **The digestive system in birds**

(Numbers in the text identify birds in our survey listed below)

The digestive system transforms food into the components that can be absorbed across the intestinal wall into the blood stream to provide the nutrients needed to support life. Foods contain simple and complex carbohydrates, fats, proteins, smaller organic compounds (vitamins) and mineral elements. Foods are digested with the aid of enzymes secreted in various parts of the alimentary tract thereby releasing simple sugars from carbohydrates, amino acids from proteins, and free fatty acids from fats. Foods must be macerated to make components accessible to enzymes, seed coats need to be opened, and lipids need to be emulsified. The normal food taken by a species may contain material that is not a substrate for the digestive enzymes present. In such cases the digestive system contains specialized areas where microorganisms assist in digestion, producing small molecules that can also be absorbed. Microorganisms are usually found in the lower digestive tract and in *organs* such as the caeca or, in rare cases, the crop where bacterial activity also produces absorbable short chain fatty acids. The overall length of the digestive system seems to reflect the relative ease of digestion of the usual food supply. The small intestines of some birds are quite long and so may provide an environment where microorganisms can digest food components. Examination of the drawings of the various alimentary tracts<sup>1</sup> shows wide variation in the structure and size of the caeca. The form and function of avian caeca were the subject of an extensive review by Clench & Mathias (1995). The observations in our drawings are consistent with theirs. In many species the caeca are long and well developed. In others, however, they are small (Song Thrush, 98), rudimentary (Magnolia Warbler, 111) or absent (Belted Kingfisher, 66). The three herons in our survey (5, 6 and 7) each had one small caecum.

Generally, species feeding on fibrous diets appear to have large caeca, an observation consistent with their role being that as a site of microbial digestion. Red Grouse (22) feed largely on shoots of young heather, a plant with relatively little readily digestible carbohydrate (Moss & Parkinson, 1972). Grouse possess two long caeca where considerable microbial fermentation promotes the release of energy from this highly fibrous food. Clench & Mathias cite data where caecal length was much longer in several species of Ptarmigan, Grouse and Quail in winter, when less digestible food was available, than in spring when young succulent plants

1 See: Anatomical drawing, beginning on page 11.

emerged as food. Thus caecal size can be variable depending on the diet consumed. In a study conducted using caecectomized young chickens, the apparent digestibility of a heat damaged protein was much less than in intact chickens (Nesheim & Carpenter, 1967). DWTC helped in the surgical preparation of the caecectomized chickens thereby marking the beginning of our many years of collaborative research. According to Clench and Mathias, the small caeca of many species contain mainly lymphatic tissue, suggesting some immunological function as yet not well understood. Interestingly, in the domesticated fowl (27), there is histological evidence for the presence of lymphatic tissue at the point where the caeca join the junction between the small intestine and the coprodeum (PJ Clarke, Personal communication).

In the Hoatzin, crop fermentation been shown to assist in the digestion of fibrous foods (Godoy-Vitorino, Ley *et al*, 2008). This means that, as in ruminant mammals, the digestion of complex carbohydrates begins before that of protein. The crop in several families of birds has rather significant storage capacity (30,51,129) and may together with the oesophagus facilitate food storage in times when a bird can exploit a plentiful food supply. The Gray Heron (5) had an oesophagus containing several small fish that were probably caught when the bird found a shoal. The Canada Goose (8) has been described as having significant amounts of food in its oesophagus after prolonged feeding, perhaps another illustration of temporary storage. In other birds the crop may serve this function. The Hooded Vulture (19) has to seize food quickly against competition from other scavengers. While the Pelican (3) has specialized mouth parts for this purpose.

The ventriculus (gizzard) is a muscular structure prominent in seed eaters and those birds that consume plant material. Ventricular contractions macerate and grind foods exposing them to digestive enzymes. Some birds ingest grit that remains in the ventriculus and helps maceration. In the ventriculus food is mixed with the acid and proteolytic enzymes secreted by the proventriculus and the digestive process continues. In most of the alimentary tracts in our survey we have been able to identify the pancreas and gall bladder along with associated ducts. The pancreas secretes several enzymes essential for digestion and the gall bladder is a reservoir for bile. Bile is important in the digestion and absorption of fat. Some details of the anatomy of the gall bladder and associated ducts have been illustrated by Crompton & Nesheim (1972).

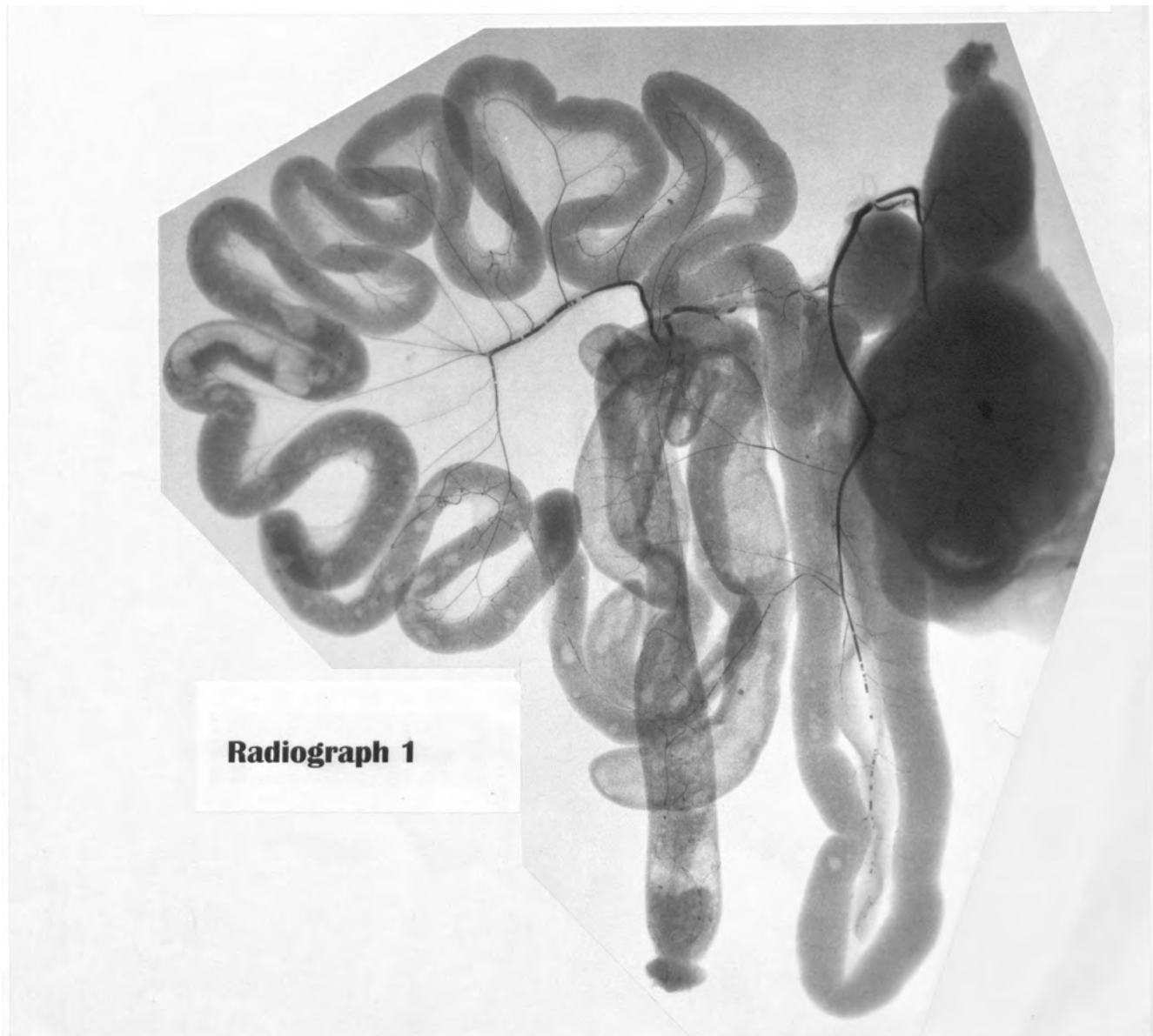
Overall in healthy warm-blooded vertebrates, the efficient digestion of normal food is influenced by the length of the alimentary tract and the rate of intestinal motility in different parts of the tract. These factors, in operation with the activity of digestive and absorptive processes, lead to varying chemical conditions along the alimentary tract. Such changes help to define the habitats occupied by different species of helminth. The tract is easily entered and stages that will infect the next host are easily dispatched. Host digestion products and intestinal tissues provide food for helminths. In mammals, and probably birds, the tract seems to be an immunoprivileged site for helminths in the lumen; the full range of lymphocytes and antibodies have not been found in the alimentary tract.

## Observations on the alimentary tract of the Domesticated Fowl (*Gallus gallus*, 27)

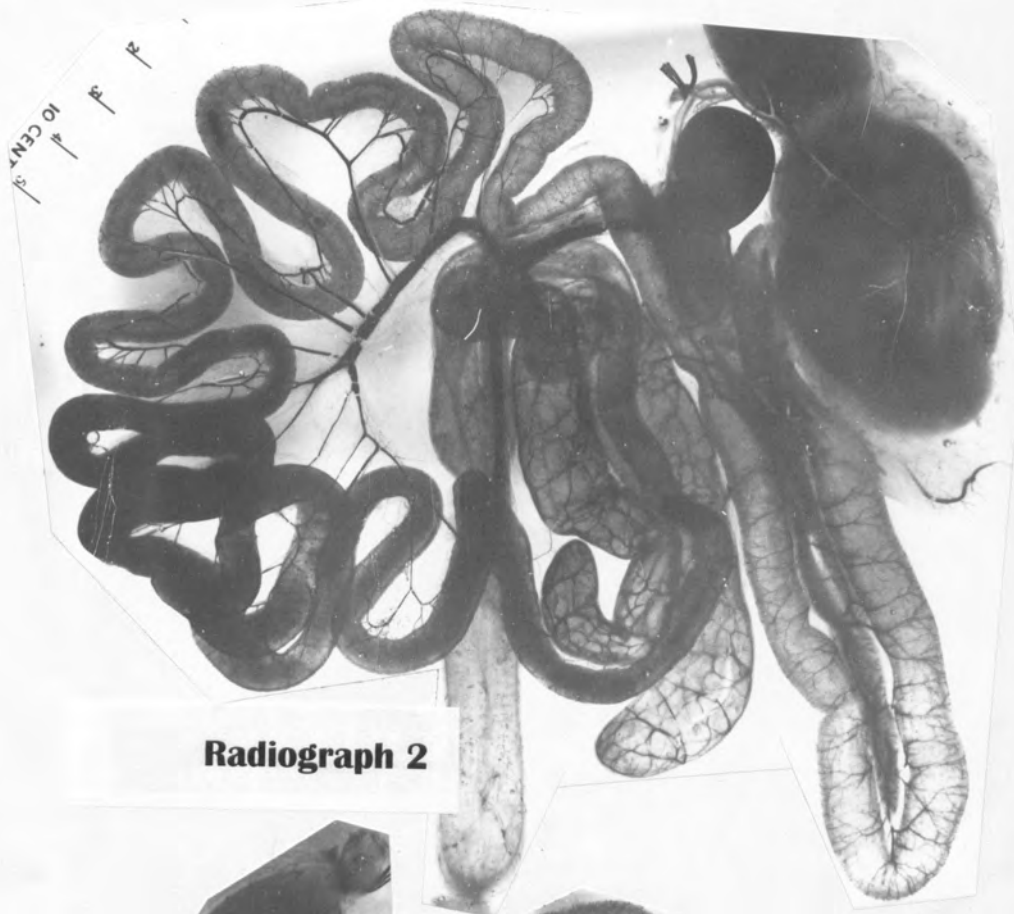
The tract of the fowl was investigated as an aid to help with the interpretation of our survey of the tracts of wild birds. Some results are already available in Crompton (1976) and Crompton & Nesheim (1976). In Crompton (1976) preparations leading to figs 1 and 2 were facilitated by Andre Bensadoun; the drawings were made by Paula DiSanto Bensadoun.

### Radiographs

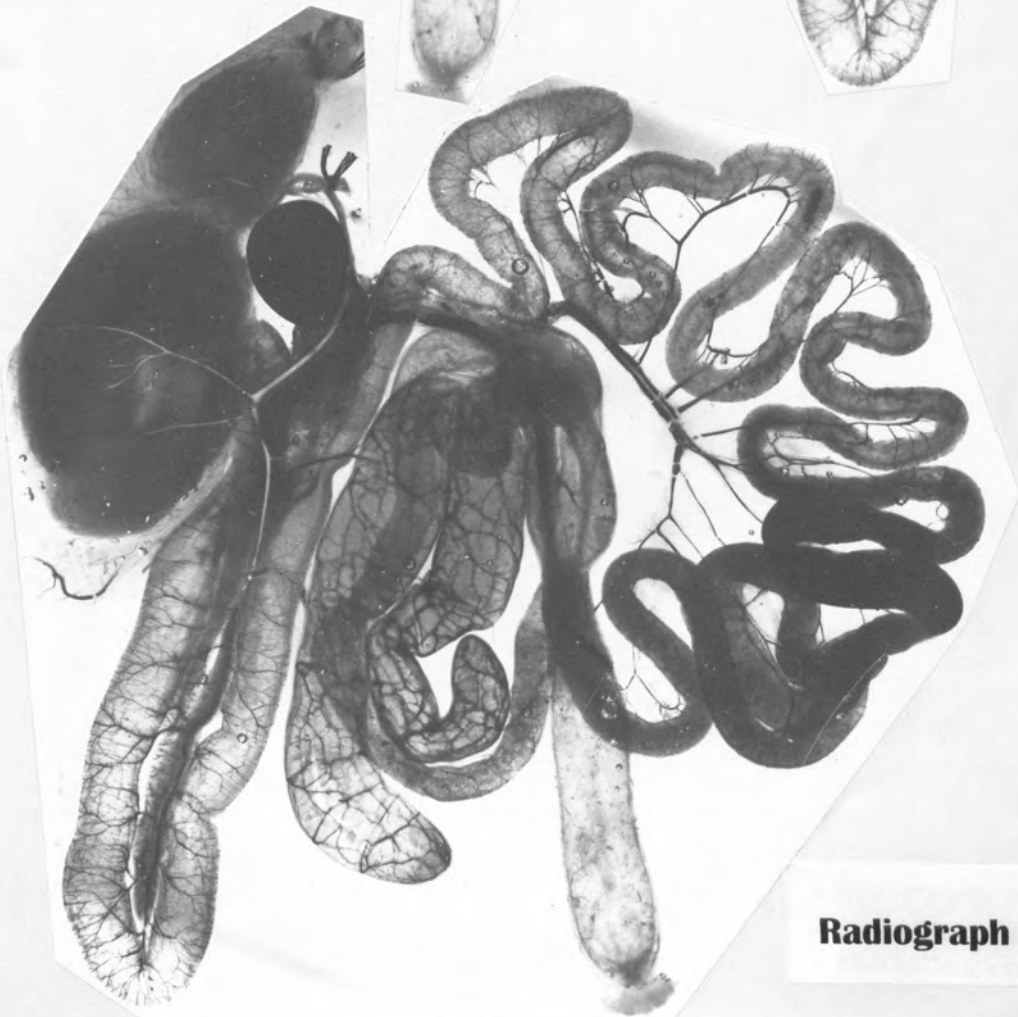
Radiographs 1, 2, 3 and 4 (below) were obtained on 5th December 1974 through the expertise and skill of Roger Akester, Sub -department of Veterinary Anatomy, University of Cambridge. Anesthesia was induced in an adult female fowl by brachial intravenous injection of 2ml urethane/Nembutal mixture. The right femoral artery was cannulated and more Nembutal was added to achieve euthanasia. A solution of micropaque was gradually introduced (1 ml up to 4ml at a time) and radiographs were taken with the bird arranged in various positions. Exposures ranged from 52KV 32ms to 40KV 10m AS. The procedure revealed the vascular supply to the alimentary tract crucial for maintenance, growth, tissue repair, digestion, absorption and helminths. These radiographs do not show the tract *in situ*.







**Radiograph 2**



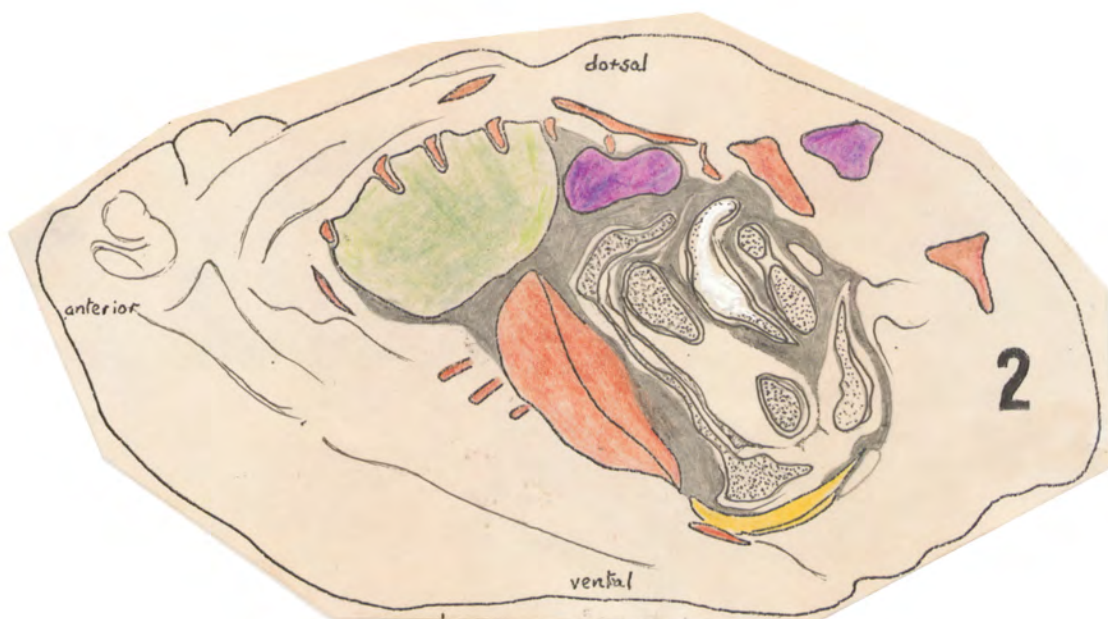
**Radiograph 3**

**Radiograph 4**

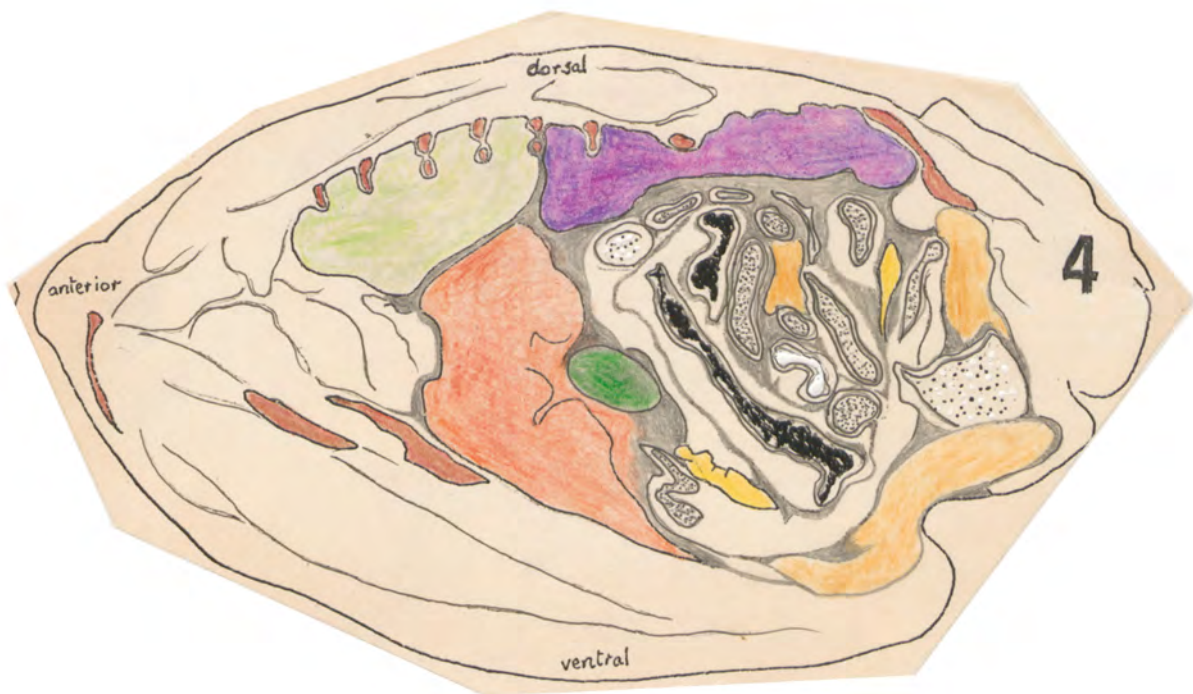
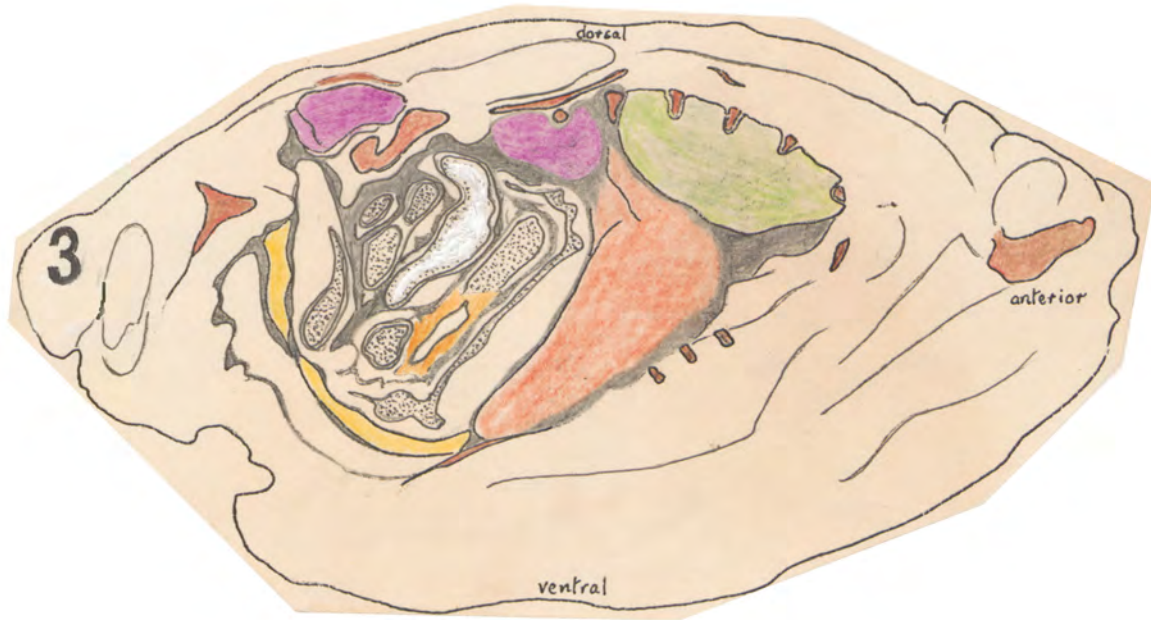


## Sagittal sections

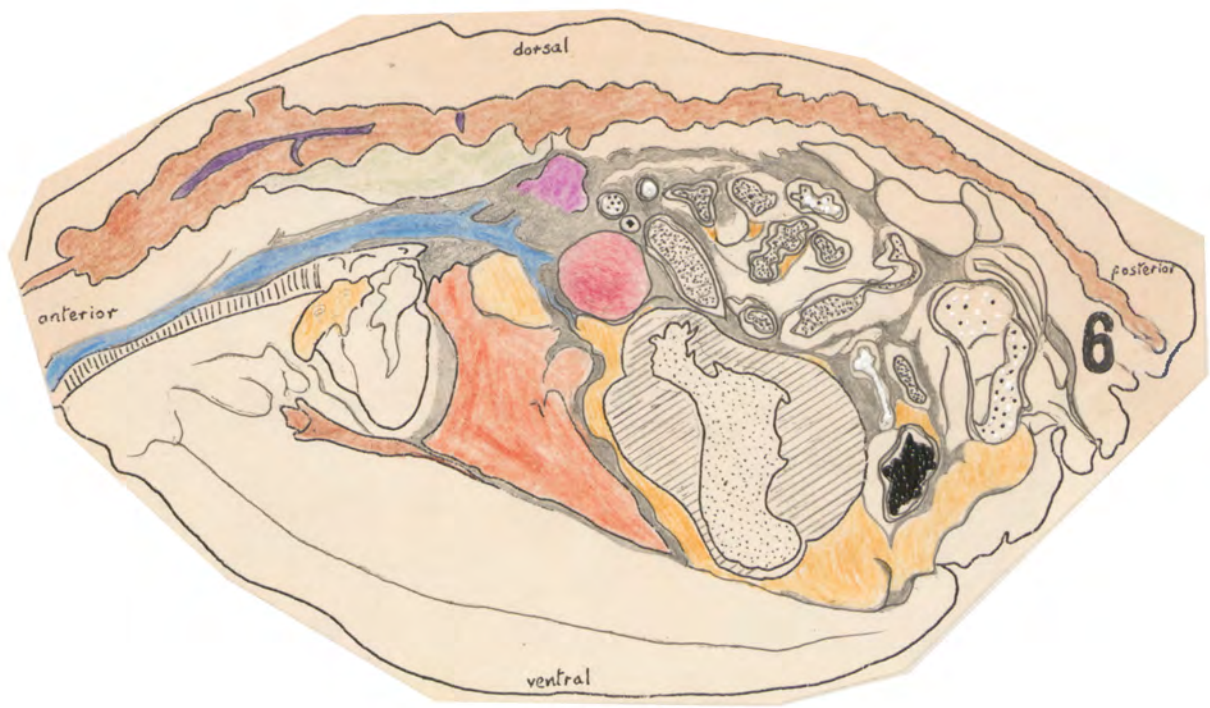
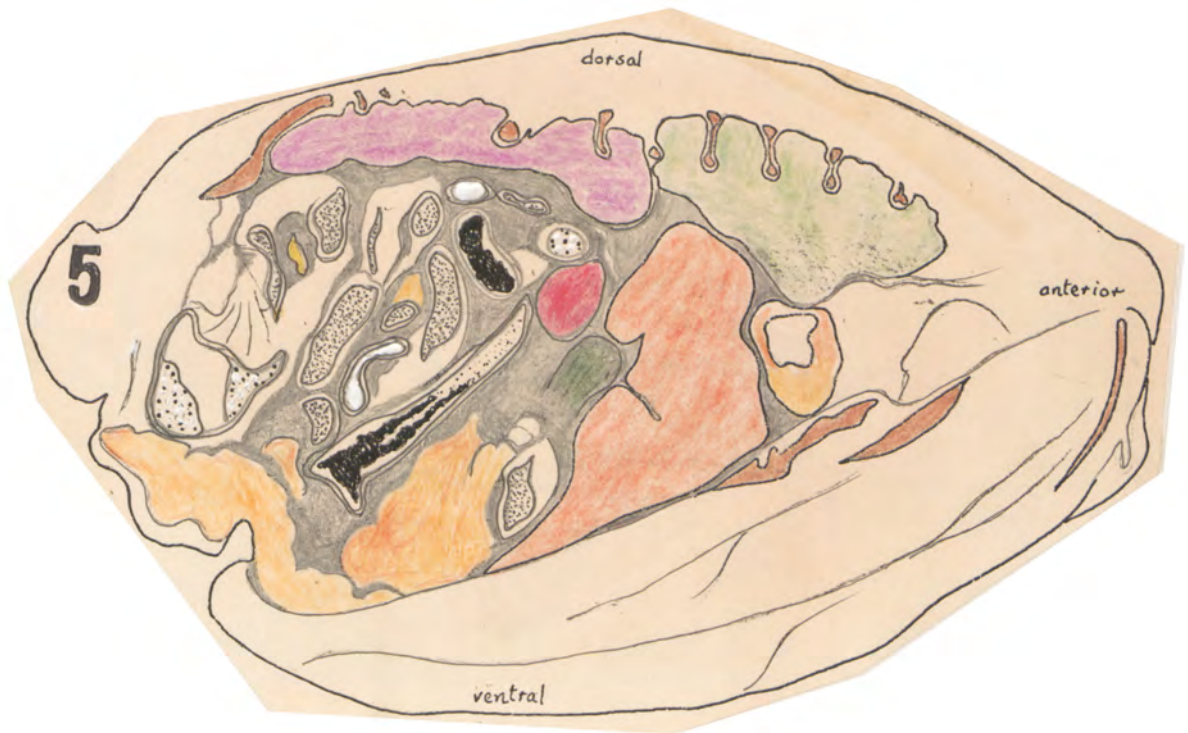
**Sagittal sections** 2, 3, 4, 5, 6, 7, 8 and 9 (below) were obtained through the skill and expertise of John Cash, Department of Anatomy, University of Cambridge. Anesthesia was induced in a young fowl on 24th October 1974. Black ink was injected in to one caecum and white ink in to the other followed by euthanasia. The body was skinned, limbs were removed and lateral incisions were made to enable 5% formalin to penetrate. After 24h, the preparation was submerged in a solution of 10% formic acid made up in 10% formalin to decalcify bone. Eight days later, after washing for 8h in running water, the preparation was immersed for periods of 24h each in 5%, 10% and 20% gelatine, cooled and fixed overnight in 5% formalin. Finally, the preparation was held in a jig and sections about 1cm thick were cut with a sharp knife. Drawings were made and colored to identify tissues and organs visible on one side of each section. Section 1 was discarded.

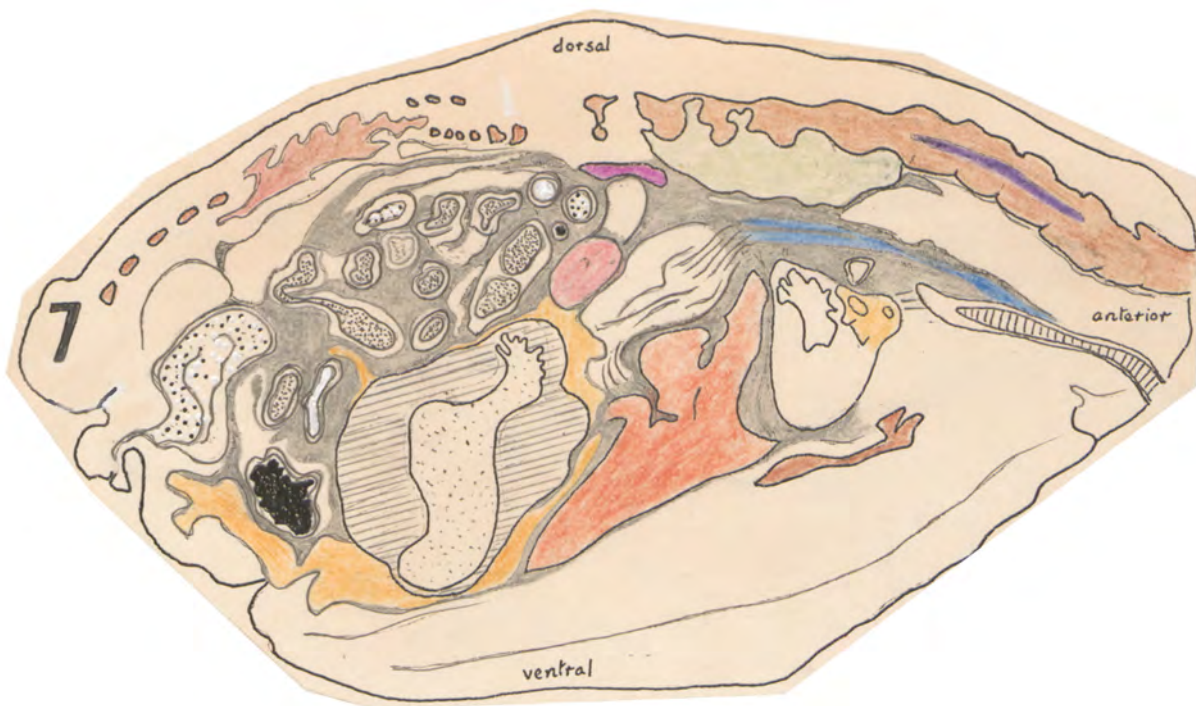




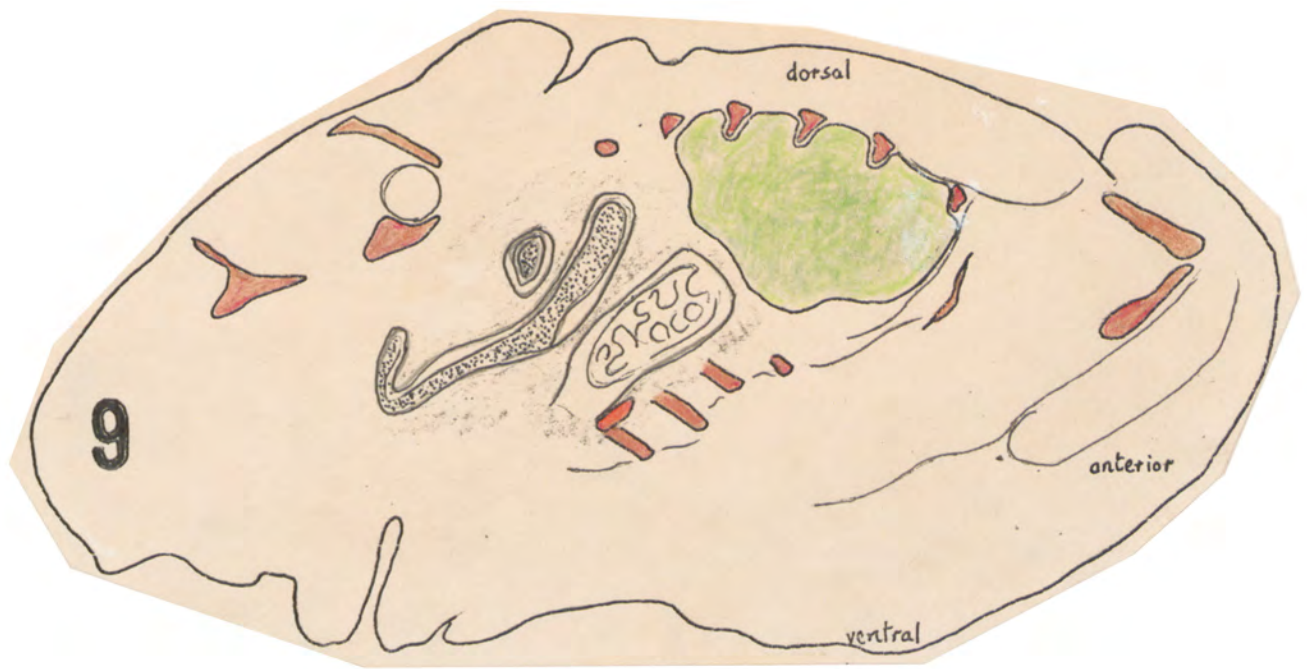












## Anatomical drawings

Species of bird examined in the survey are arranged according to the check list published by Clements (1974)

The alimentary tracts of 151 birds from 52 families were examined and drawn during the survey. Of these, 7 were domesticated birds (10<sup>1</sup>, 11, 27, 31, 52, 53 and 134), 3 were not identified as far as species (15, 52 and 53); one of these was a hybrid duck (15). Three pairs of birds (46 & 47, 77 & 78 and 146 & 147) were included. The rock doves (46 & 47) permitted comparison between wild and feral representatives, the swallows (77/78) between the same species in different continents, and the tree sparrows (146/147) between two individuals from similar habitats.

1. Most specimens were handled under license from the New York State Department of Environmental Conservation (Bureau of Wildlife) and the UK Nature Conservancy Council.
2. Dates on the drawings may indicate when the bird was obtained, when it reached the donor or when its tract was displayed and examined. The location of a specimen does not always indicate its origin.
3. The provenance of each specimen and how it was examined are set out with its drawing. Many specimens had been stored frozen. These were thawed at room temperature in an aqueous solution of 5% formaldehyde (formalin). Some were photographed with a Polaroid camera for the scale.
4. Colleagues who provided specimens are named on the drawings. We are extremely grateful to them for their help and their cooperation that made possible this set of observations.
5. Some of the names used by Clements (1974) may have changed since his publication. Taxonomists regularly revise classifications hence changes. Nevertheless, despite any differences, we have found Clements' list to be most useful.
6. John James Audubon in his *The Birds of America* (published between 1840 and 1844) included descriptive comments about the alimentary tracts of many birds; sometimes he provided drawings. We have added to our drawings pages in the Dover edition (1967) where reproductions of his drawings can be seen. For example, in the case of the Ruffed Grouse (23), JJA v5, p82 directs to Audubon's drawing in volume 5, page 82 of the Dover edition (1967).
7. We have added brief dietary notes based on information from the Internet, on entries in *A Dictionary of Birds* (Campbell & Lack, 1985), on field guides available to bird watchers, or on observations made during dissection.
8. Related anatomical information can be found in the work of Gadow (1879).

1      These numbers refer to the following drawings.

## NON-PASSERINES

Note: If using the Adobe Acrobat Reader (or the full version) with the digital version (PDF), click a numbered entry below to scroll to the associated drawing; use the “previous view” command to return.

### Tinamidae (Tinamous)

- 1 *Crypturellus soui* (Little Tinamou)
- 2 *Eudromia elegans* (Elegant Crested Tinamou)

### Pelicanidae (Pelicans)

- 3 *Pelicanus roseus* (White Pelican)

### Phalacrocoracidae (Cormorants)

- 4 *Phalacrocorax auritus* (Double-crested Cormorant)

### Ardeidae (Hérons)

- 5 *Ardea cinerea* (Gray Heron)
- 6 *Ardea herodias* (Great Blue Heron)
- 7 *Nictanassa violacea* (Yellow-crowned Night Heron)

### Anatidae (Ducks and Geese)

- 8 *Branta canadensis* (Canada Goose)
- 9 *Anser brachyrhynchus* (Pink-footed Goose)
- 10 *Anser anser domesticus* (Domesticated Goose)
- 11 *Anos platyrhynchos* (Mallard; domesticated Kharki Campbell)
- 12 *Anas rubripes* (American Black Duck)
- 13 *Anas americana* (American Wigeon)
- 14 *Bucephalus clangula* (Common Goldeneye)
- 15 *Anas sp.* (Hybrid duck)

### Accipitridae (Hawks)

- 16 *Buteo jamaicensis* (Red-tailed Hawk)
- 17 *Buteo buteo* (Common Buzzard)
- 18 *Aquila rapax* (Tawny Eagle)
- 19 *Necrosyrtes monarchus* (Hooded Vulture)

### Falconidae (Falcons)

- 20 *Falco mexicanus* (Prairie Falcon)
- 21 *Falco tinnunculus* (Eurasian Kestrel)

**Tetraonidae (Grouse)**

22 *Lagopus scoticus* (Red Grouse)

23 *Bonansa umbellus* (Ruffed Grouse)

**Phasianidae (Pheasants)**

24 *Colinus virginianus* (Bobwhite/Bobwhite Quail)

25 *Perdix perdix* (Partridge)

26 *Coturnix coturnix* (European [Japanese] Quail)

27 *Gallus gallus* (Red Jungle Fowl/Domesticated Fowl)

28 *Phasianus colchicus* (Ring-necked Pheasant)

29 *Pavo cristatus* (Common Peafowl/Peacock)

**Numididae (Guinea fowl)**

30 *Numida meleagris* (Tufted Guinea fowl)

**Meleagrididae (Turkeys)**

31 *Meleagris gallopavo* (Common Turkey)

**Gruidae (Cranes)**

32 *Grus canadensis* (Sandhill Crane)

**Rallidae (Rails)**

33 *Gallinula chloropus* (Moorhen)

34 *Fulica atra* (Coot)

**Charadriidae (Plovers)**

35 *Vanellus vanellus* (Northern Lapwing)

36 *Charadrius semipalmatus* (Semi-palmated Plover)

**Scolopacidae (Sandpipers)**

37 *Capella gallinago* (Common Snipe)

38 *Scolopax rusticola* (Eurasian Woodcock)

39 *Philohela minor* (American Woodcock)

40 *Calidris minutilla* (Least Sandpiper)

41 *Calidris alpina* (Dunlin)

**Stercorariidae (Skuas)**

42 *Catharacta skua* (Great Skua “Bonxie”)

## **Laridae**

- 43 *Larus argentatus* (Herring Gull)
- 44 *Larus marinus* (Great Black-backed Gull)
- 45 *Laus ridibundus* (Black-headed Gull)

## **Columbidae (Pigeons and Doves)**

- 46 *Columba livia* (Rock Dove from India)
- 47 *Columba livia* (Rock Dove: Feral Pigeon/City Pigeon)
- 48 *Zenaida macroura* (Mourning Dove)
- 49 *Streptopelia turtur* (Turtle Dove)
- 50 *Claravis pretiosa* (Blue Ground Dove)

## **Psittacidae (Parrots)**

- 51 *Melopsittacus undulates* (Budgerigar)
- 52 *Agapornis spp.* (Love Bird)
- 53 *Loriculus spp.* (Hanging Parrot)

## **Musophagidae (Turacos)**

- 54 *Crinifer leucogaster* (White-bellied Go-away Bird)

## **Cuculidae (Cuckoos)**

- 55 *Coccyzus americanus* (Yellow-billed Cuckoo)

## **Tytonidae (Barn Owls)**

- 56 *Tyto alba* (Barn Owl)

## **Strigidae (Owls)**

- 57 *Otus asio* (Screech Owl)
- 58 *Bubo virginianus* (Great Horned Owl)
- 59 *Athene noctua* (Little Owl)
- 60 *Ciccaba virgata* (Mottled Owl)
- 61 *Strix aluco* (Tawny Owl)

## **Caprimulgidae (Nightjars)**

- 62 *Chordeiles minor* (Common Nighthawk)

### **Trochilidae (Hummingbirds)**

63 *Eugenes fulgens* (Magnificent [Rivoli's] Hummingbird)

64 *Archilochus colubris* (Ruby-throated Hummingbird)

### **Coliidae (Colies)**

65 *Colius striatus* (Speckled Mousebird)

### **Alcedinidae (Kingfishers)**

66 *Ceryle alcyon* (Belted Kingfisher)

67 *Alcedo atthis* (Common Kingfisher)

### **Upupidae (Hoopoes)**

68 *Upupa epops* (Common Hoopoe)

### **Indicatoridae (Honeyguides)**

69 *Indicator minor* (Lesser Honeyguide)

### **Picidae (Woodpeckers)**

70 *Colaptes auratus* (Yellow-shafted Flicker/Common Flicker)

71 *Sphyrapicus varius* (Yellow-bellied Sapsucker)

72 *Dendrocopos minor* (Lesser Spotted Woodpecker)

73 *Dendrocopos pubescens* (Downy Woodpecker)

## **PASSERIFORMES (Perching Birds)**

### **Dendrocolaptidae (Woodcreepers)**

74 *Xiphorhynchus flavigaster* (Ivory-billed Woodcreeper)

### **Tyrannidae (Tyrant Flycatchers)**

75 *Megarhynchus pitangua* (Boat-billed Flycatcher)

### **Alaudidae (Larks)**

76 *Alauda avensis* (Eurasian Skylark)

### **Hirundinidae (Swallows)**

77 *Riparia riparia* (Bank Swallow/Sand Martin)-North America

78 *Riparia riparia* (Sand Martin/Bank Swallow)-Europe

79 *Hirundo rustica* (Swallow/Barn Swallow)



### **Corvidae (Crows and Jays)**

- 80 *Cyanocitta aristata* (Blue Jay)
- 81 *Pica pica* (Black-billed Magpie/Magpie)
- 82 *Corvus monedula* (Jackdaw)
- 83 *Corvus frugilegus* (Rook)
- 84 *Corvus corone* (Carrion Crow)
- 85 *Corvus corax (ruficollis)* (Common Raven)

### **Paridae (Titmice)**

- 86 *Parus atricapillus* (Black-capped Chickadee)
- 87 *Parus caeruleus* (Blue Tit)

### **Certhidae (Creepers)**

- 88 *Certhia familiaris* (Tree Creeper/Brown Creeper)

### **Troglodytidae**

- 89 *Telmatodytes palustris* (Long-billed Marsh Wren)
- 90 *Troglodytes troglodytes* (Wren)

### **Mimidae (Mocking Birds and Thrashers)**

- 91 *Dumetella carolinensis* (Catbird)
- 92 *Toxostoma rufum* (Brown Thrasher)

### **Turdidae (Thrushes)**

- 93 *Erithacus rubecula* (Robin)
- 94 *Catharus fuscescens* (Veery)
- 95 *Catharus ustulata* (Swainson's Thrush)
- 96 *Catharus mustelina* (Wood Thrush)
- 97 *Turdus merula* (Blackbird)
- 98 *Turdus philomelos* (Song Thrush)
- 99 *Turdus migratorius* (American Robin)

**Sylviidae (Old World Warblers)**

100 *Regulus satrapa* (Golden-crowned Kinglet)

**Prunellidae (Hedge Sparrows)**

101 *Prunella modularis* (Dunnock/Hedge Sparrow)

**Bombycillidae (Waxwings)**

102 *Bombycilla cedrorum* (Cedar Waxwing)

**Laniidae (Shrikes)**

103 *Lanius excubitor* (Northern Shrike)

**Sturnidae (Starlings)**

104 *Sturnus vulgaris* (Common Starling)

**Nectariniidae (Sunbirds)**

105 *Anthreptes longuemarei* (Violet-backed Sunbird)

**Vireonidae (Vireos)**

106 *Vireo solitarius* (Solitary Vireo)

107 *Vireo olivaceus* (Red-eyed Vireo)

**Parulidae (American Wood-Warblers)**

108 *Mniotilta varia* (Black-and White Warbler)

109 *Vermivora ruficapilla* (Nashville Warbler)

110 *Dendroica petechia* (Yellow Warbler)

111 *Dendroica agnolia* (Magnolia Warbler)

112 *Dendroica caerulescens* (Black-throated Blue Warbler)

113 *Dendroica virens* (Black-throated Green Warbler)

114 *Dendroica fusca* (Blackburnian Warbler)

115 *Dendroica pensylvanica* (Chestnut-sided Warbler)

116 *Dendroica castanea* (Bay-breasted Warbler)

117 *Dendroica striata* (Blackpoll Warbler)

118 *Seiurus aurocapillus* (Oven Bird)

- 119 *Geothlypis trichas* (Yellowthroat)
- 120 *Setophaga ruticilla* (American Redstart)

**Icteridae (Troupials)**

- 121 *Molothrus ater* (Brown-headed Cowbird)
- 122 *Quiscalus quiscula* (Common Grackle)
- 123 *Agelaius phoeniceus* (Red-winged Blackbird)
- 124 *Icterus galbula* (Baltimore Oriole)
- 125 *Sturnella magna* (Eastern Meadowlark)
- 126 *Dolichonyx oryzivorus* (Bobolink)

**Thraupidae (Tanagers)**

- 127 *Euphonia hirudinacea* (Yellow-throated Euphonia)
- 128 *Piranga olivacea* (Scarlet Tanager)

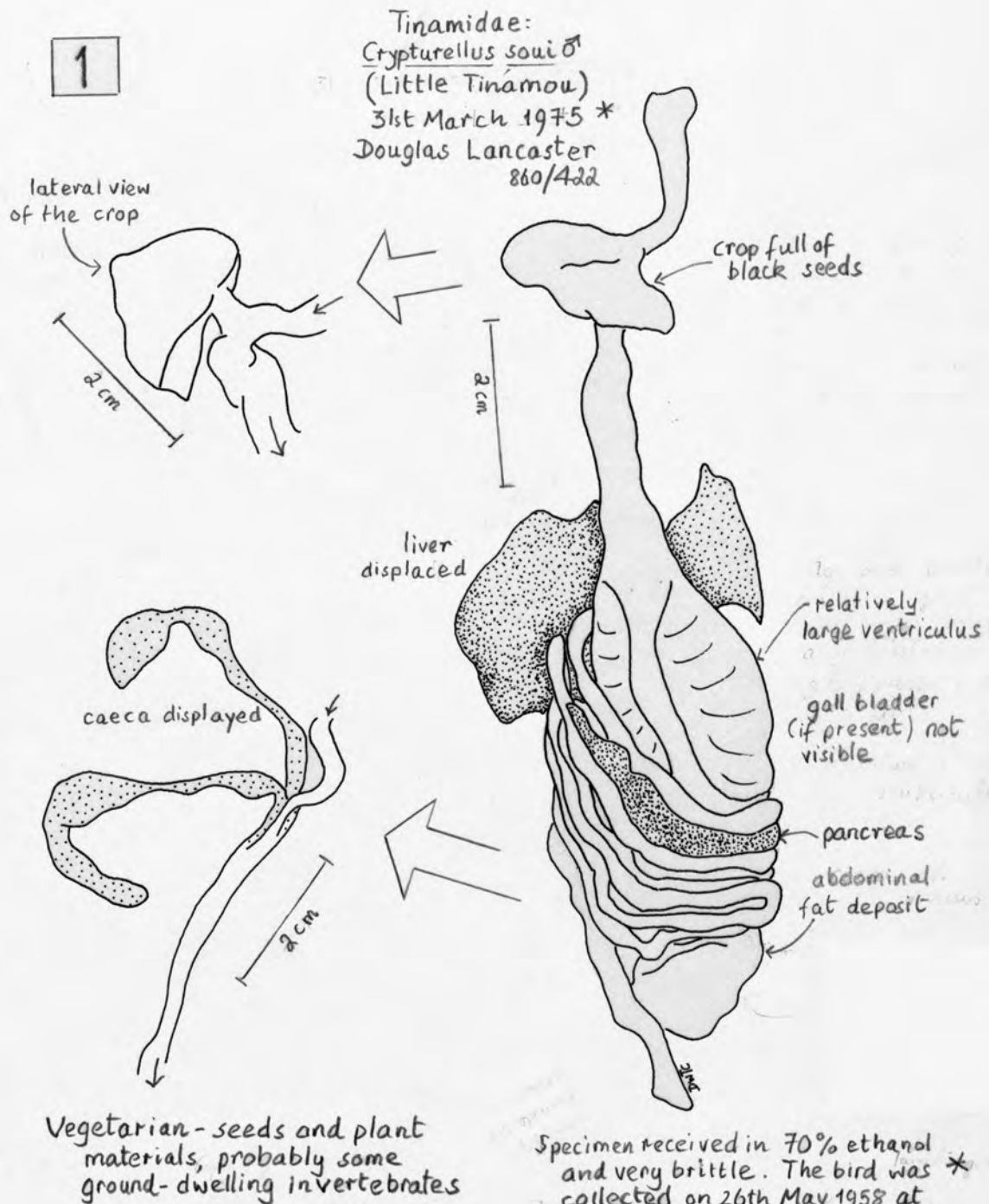
**Ploceidae (Weaverbirds)**

- 129 *Passer domesticus* (House Sparrow)

**Fringillidae (Grosbeaks, Finches, Sparrows and Buntings)**

- 130 *Cardinalis cardinalis* (Cardinal)
- 131 *Pheucticus ludovicianus* (Rose-breasted Grosbeak)
- 132 *Passerina cyanea* (Indigo Bunting)
- 133 *Fringilla coelebs* (Chaffinch)
- 134 *Serinus canaria domestica* (Eurasian Canary)
- 135 *Hesperiphona vespertina* (Evening Grosbeak)
- 136 *Pyrrhula pyrrhula* (Common Bullfinch)
- 137 *Carpodacus mexicanus* (House Finch/Linnet)
- 138 *Carduelis chloris* (Greenfinch)
- 139 *Carduelis carduelis* (Goldfinch)
- 140 *Emberiza citronella* (Yellowhammer)
- 141 *Emberiza schoeniclus* (Reed Bunting)

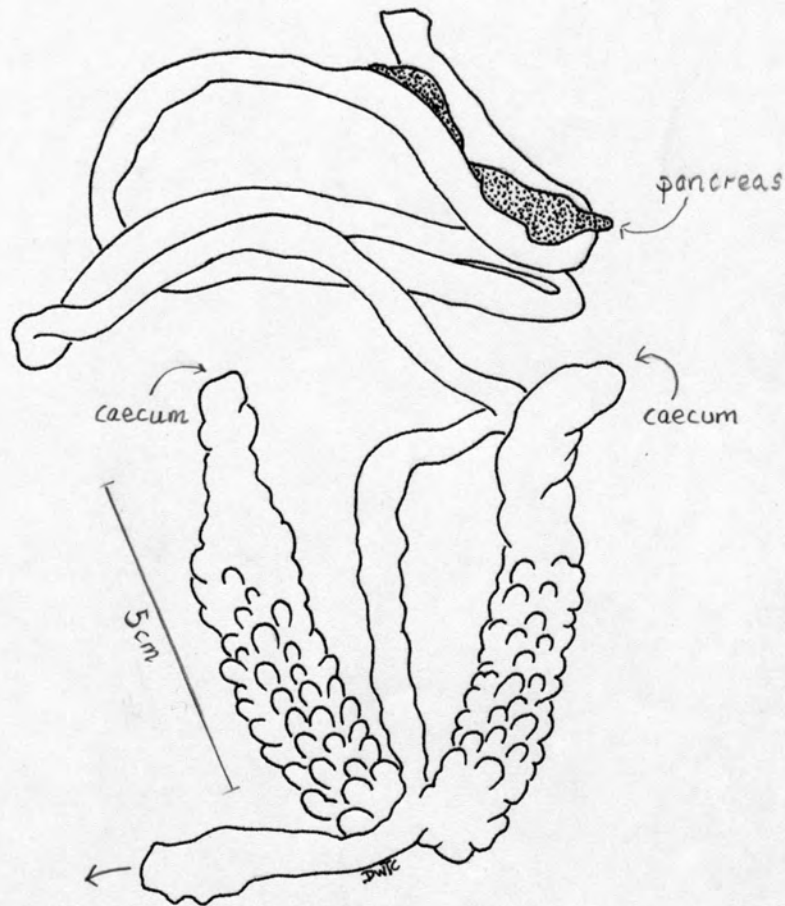
- 142 *Arremonops rufivirgatus* (Olive Sparrow)
- 143 *Ammospiza martima* (Seaside Sparrow)
- 144 *Ammospiza caudacuta* (Sharp-tailed Sparrow)
- 145 *Junco hyemalis* (Slate-colored Junco)
- 146 *Spizella arborea* (Tree Sparrow)
- 147 *Spizella arborea* (Tree Sparrow)
- 148 *Zonotrichia leucophrys* (White-crowned Sparrow)
- 149 *Melospiza lincolni* (Lincoln's Sparrow)
- 150 *Melospiza georgiana* (Swamp Sparrow)
- 151 *Melospiza melodia* (Song Sparrow)



1 *Crypturellus soui* (Little Tinamou)

2

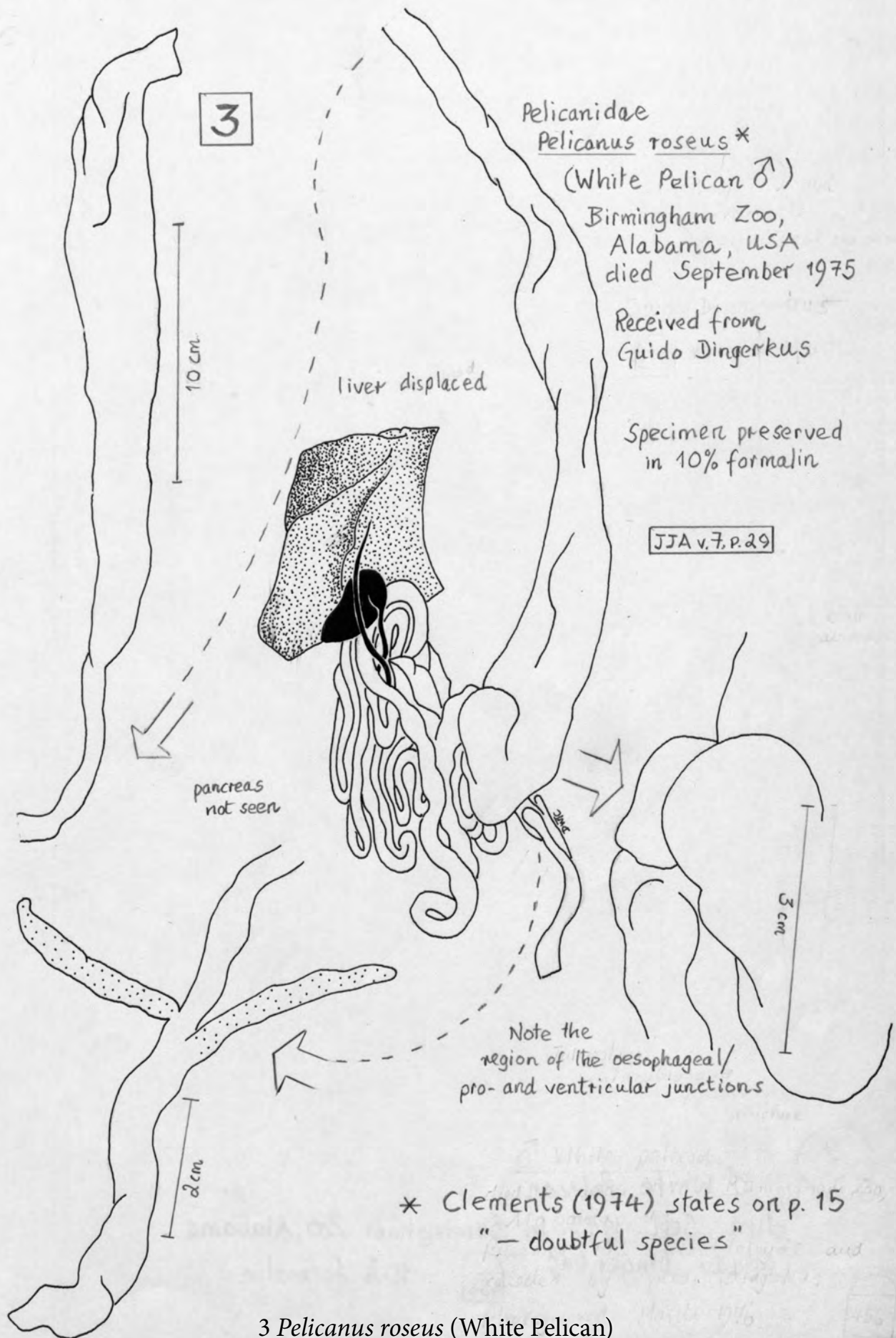
Tinamidae:  
Eudromia elegans  
(Elegant Crested Tinamou)  
1977 · John Mattocks



incomplete specimen  
fixed in 5% formalin

Vegetarian-feeding mainly on seeds and fruit

2 *Eudromia elegans* (Elegant Crested Tinamou)





4

Phalacrocoracidae:  
*Phalacrocorax auritus* ♂  
 (Double-crested cormorant)  
 September 1975. died in  
 Birmingham Zoo, Alabama, USA  
 Guido Dingerkus

JJA v. 6, p. 429

anterior part of the  
 oesophagus appears  
 capable of considerable  
 extension

liver displaced

10 cm

specimen received  
 in 10% formalin

two small caeca

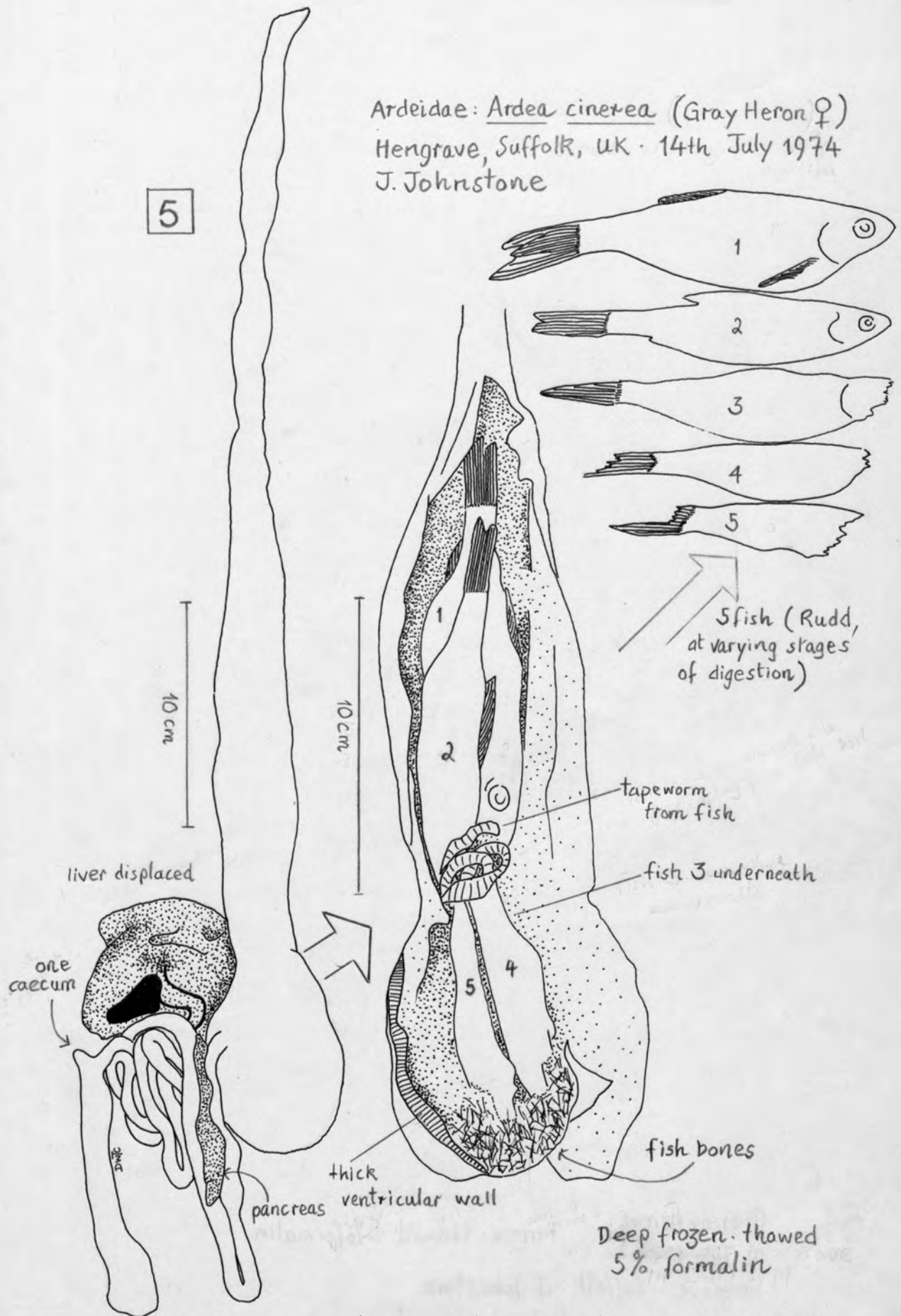
Carnivore: fish, crustaceans,  
 cephalopods

pancreas

4 *Phalacrocorax auritus* (Double-crested Cormorant)



Ardeidae: Ardea cinerea (Gray Heron ♀)  
 Hengrave, Suffolk, UK · 14th July 1974  
 J. Johnstone



5 *Ardea cinerea* (Gray Heron)

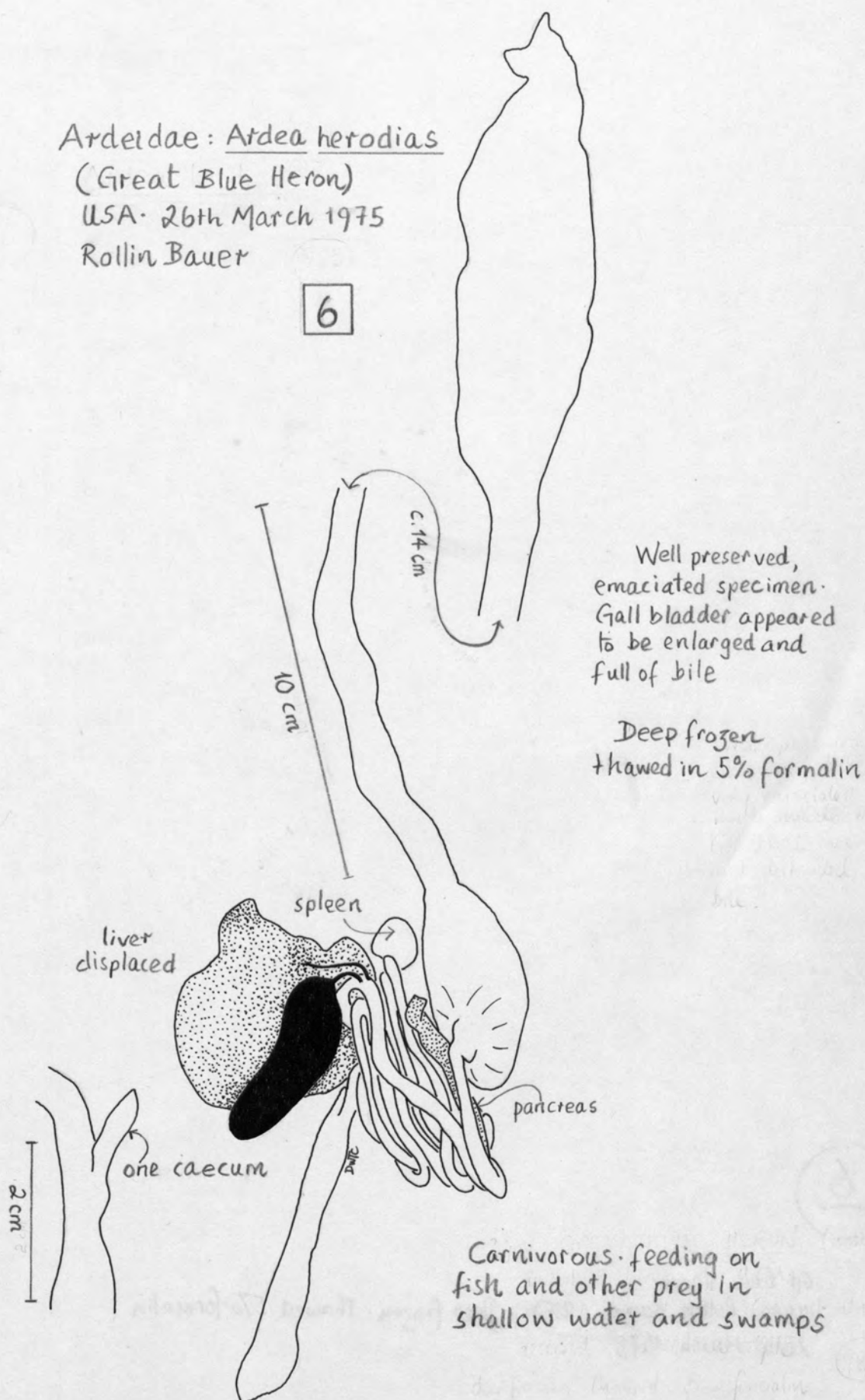
Ardeidae: Ardea herodias

(Great Blue Heron)

USA - 26th March 1975

Rollin Bauer

6



6 *Ardea herodias* (Great Blue Heron)

Ardeidae: Nictanassa violacea

(Yellow-crowned Night Heron ♂)

Millford Point, Conn., USA

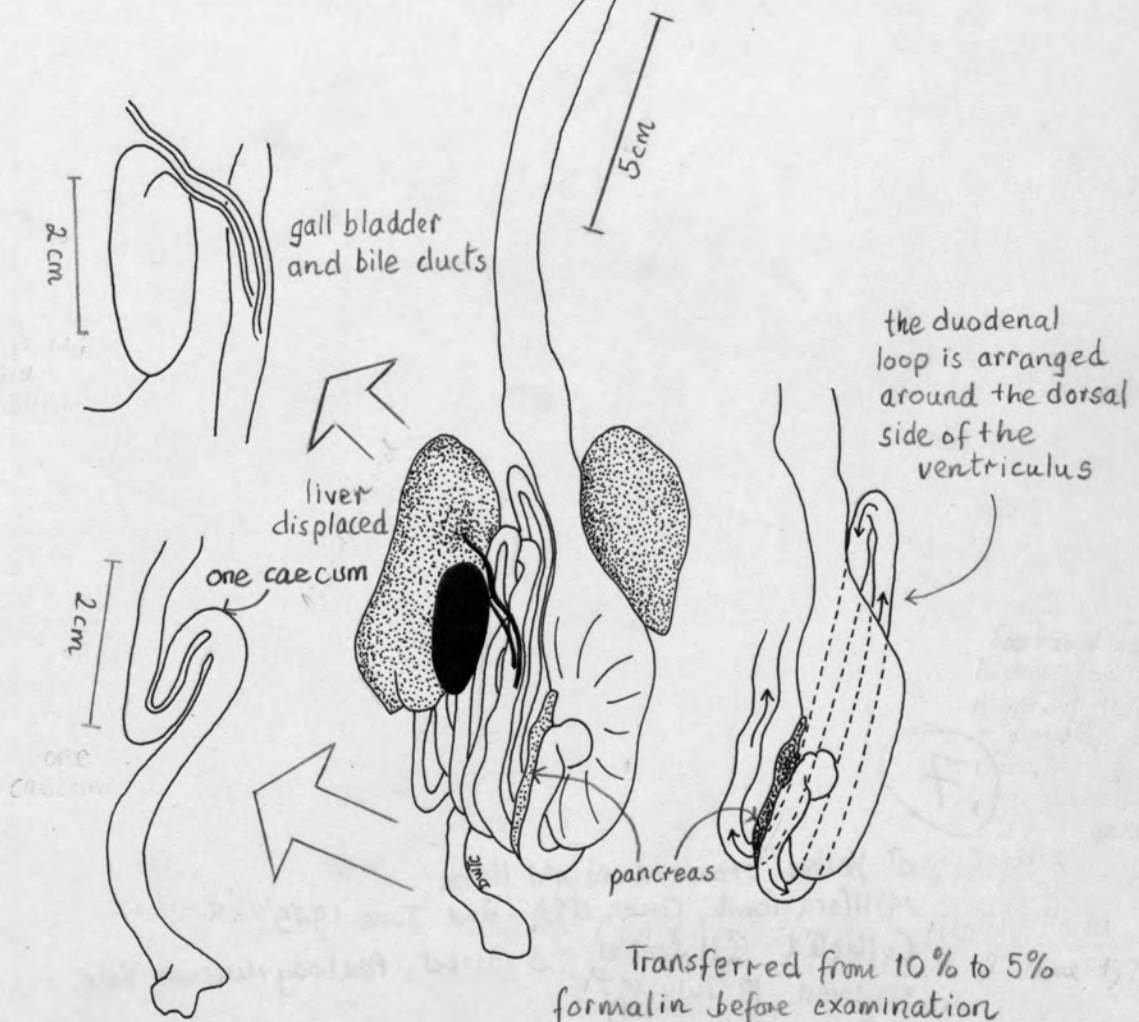
2nd June 1975

Collected by RH Barker and  
received from S. Garber,  
Peabody Museum, Yale, on  
18th July 1975

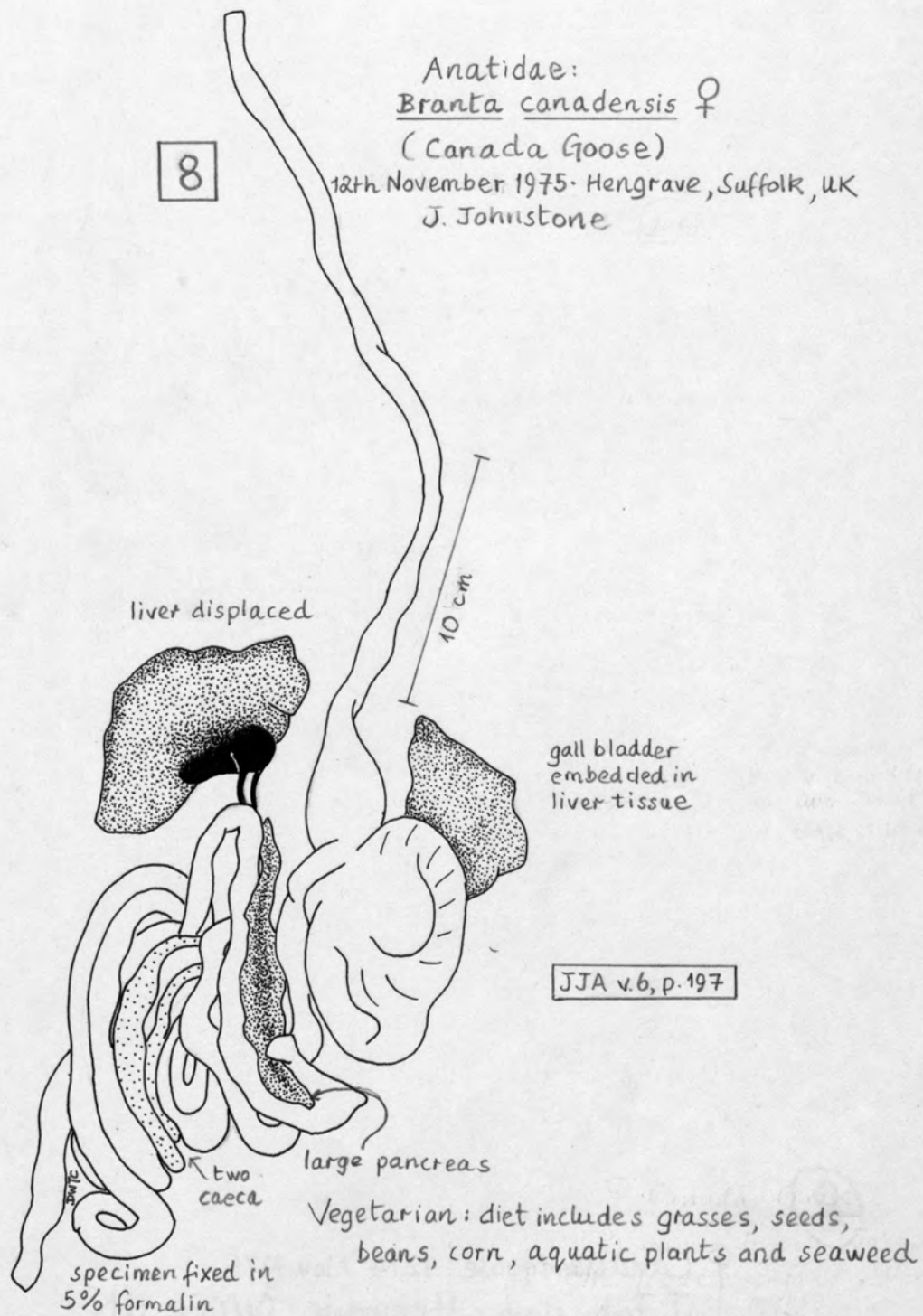
Carnivorous - feeds particularly  
on crustaceans

long very  
extensible  
oesophagus

7



7 *Nictanassa violacea* (Yellow-crowned Night Heron)



8 *Branta canadensis* (Canada Goose)

Anatidae:

Anser brachyrhynchus ♂

(Pink-footed Goose)

9th December 1974

Loch Leven, Kinross,  
Scotland, UK

A. Allison

[Nature Conservancy]

9

shape of the fat  
deposit lying  
over the pro- and  
ventriculus and  
reaching the  
caecal tips

10 cm

caecum  
c. 19 cm

caecum  
c. 15 cm

5 cm

liver displaced

gall bladder  
and bile ducts  
wrapped in  
membranes

spleen

large  
pancreas

caecal tips

Specimen arrived in  
Cambridge on 11th Dec. 1974  
having been shot in the wild and  
then injected with 5% formalin

Vegetarian: summer diet of tundra plants; winter  
diet (after migration) from gleaning remains of arable crops

9 *Anser brachyrhynchus* (Pink-footed Goose)

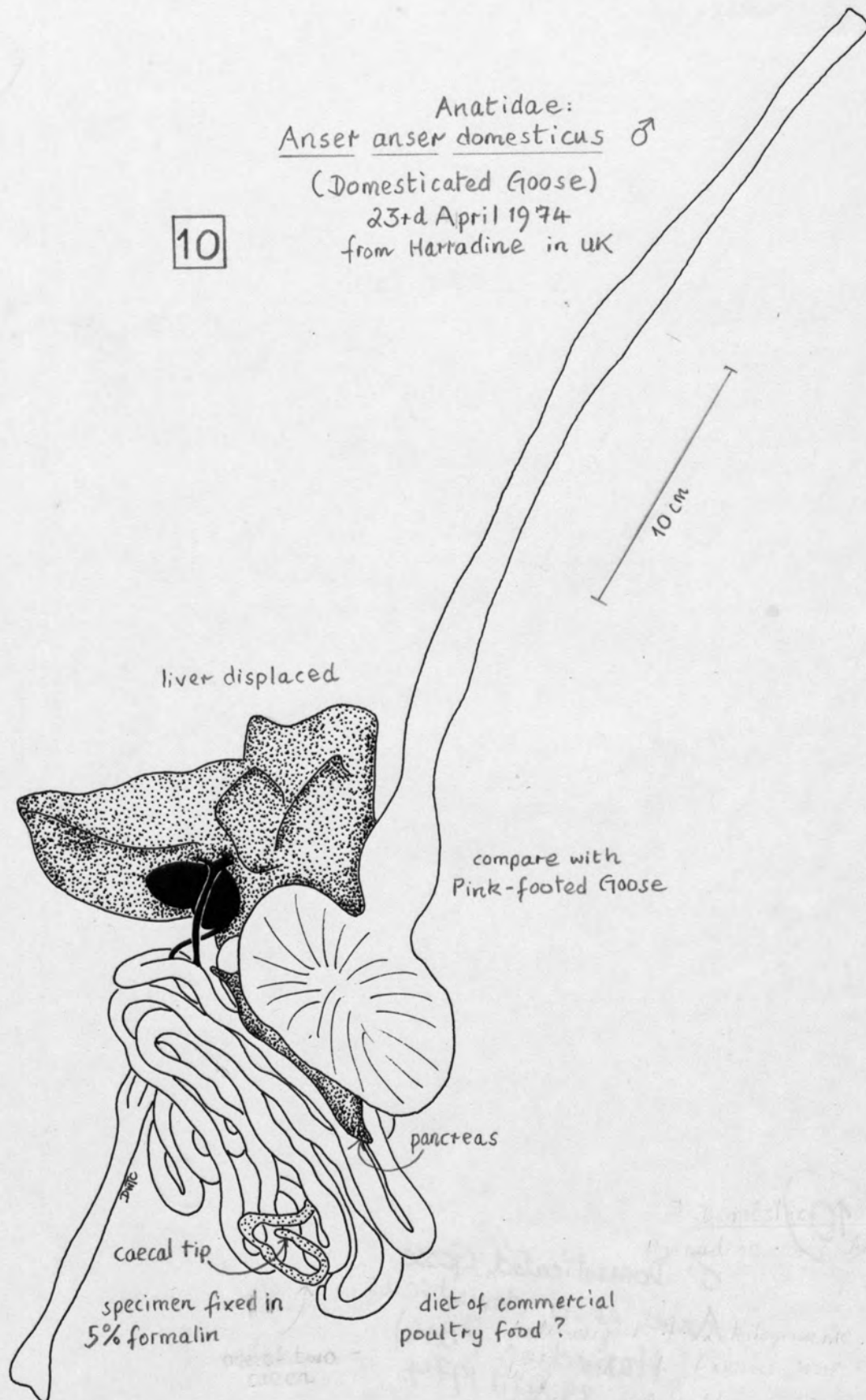


Anatidae:  
Anser anser domesticus ♂

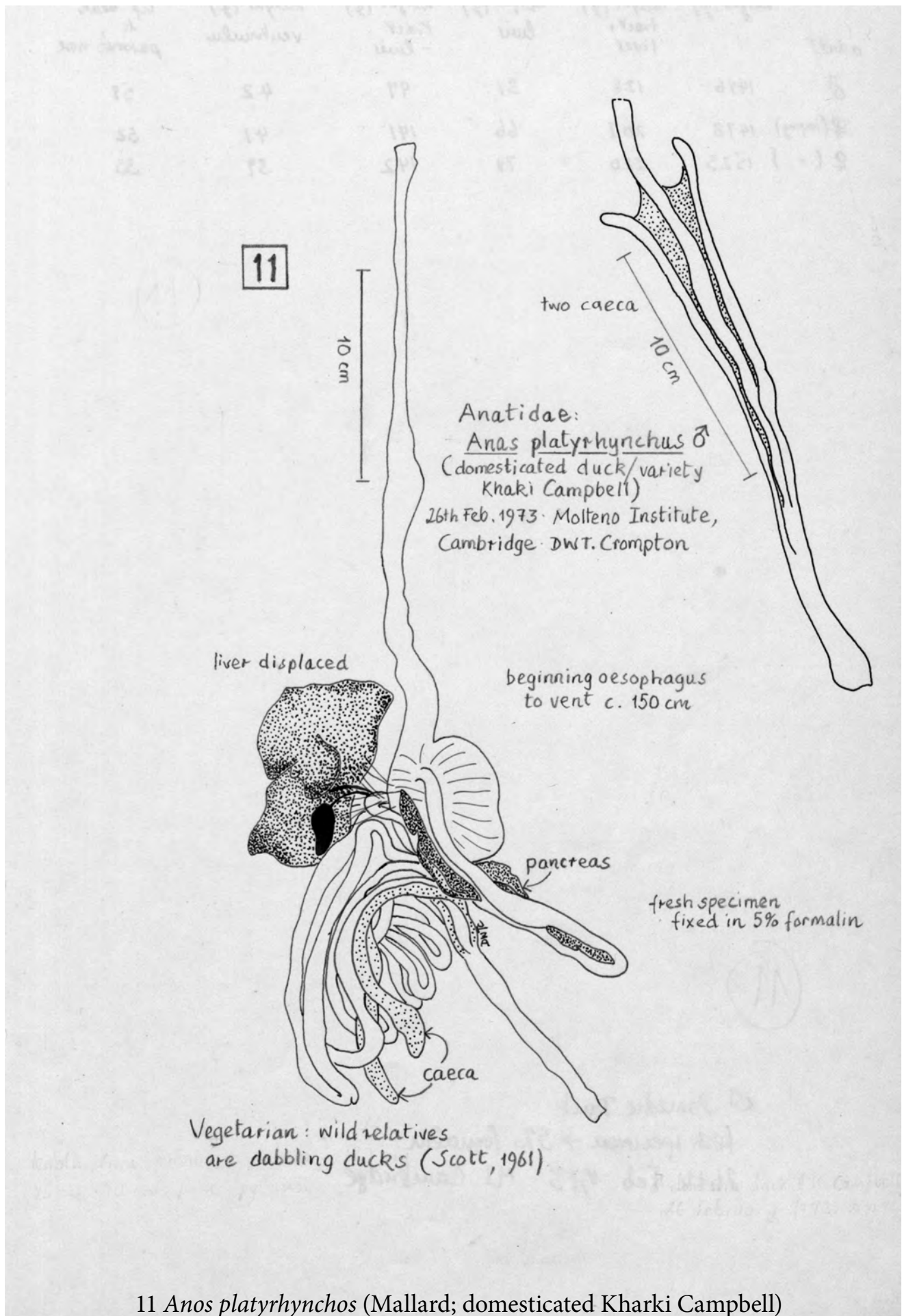
(Domesticated Goose)

23rd April 1974  
from Harradine in UK

10



10 *Anser anser domesticus* (Domesticated Goose)



12

Anatidae  
*Anas rubripes* ♂  
(American Black Duck)  
13th Feb. 1975 · Ithaca, NY, USA  
Sam Weeks

wide  
oesophagus

5 cm

liver displaced

pancreas

two long  
caeca

yolk stalk

Dabbling duck (Scott, 1961)  
feeding on vegetation  
at the surface or in  
shallow water

specimen from a bird  
found frozen by roadside  
thawed in 5% formalin

12 *Anas rubripes* (American Black Duck)



13

Anatidae:

*Anas americana* ♂

(American Widgeon)

2nd April 1975: NY State, USA

Rollin Bauer

JJA v. 6, p. 265

5cm

liver displaced

gall bladder partly  
embedded in the liver

two long caeca

pancreas

Dabbling duck (Scott, 1961)  
feeding on vegetation at the  
surface or in shallow water

specimen received  
deep frozen, thawed in water,  
transferred to 5% formalin

13 *Anas americana* (American Widgeon)

Anatidae  
Bucephalus clangula ♀  
 (Common Goldeneye)  
 26th March 1975. USA  
 Rollin Bauer

14

5 cm

liver displaced

pancreas  
 caecal end  
 caecal tip  
 two long caeca

specimen deep frozen  
 thawed in 5% formalin

Carnivore: aquatic insects,  
 molluscs, crustaceans

14 *Bucephalus clangula* (Common Goldeneye)

15

Anatidae:  
Hybrid duck ♂  
20th October 1975. Hengrave, Suffolk, UK  
J. Johnstone

40 cm

liver displaced

pancreas

prominent  
caecum  
(there were two)

Probably a  
dabbling duck (see  
Scott, 1961)

bird shot 16th Oct. 1975  
specimen received in 5% formalin  
and examined 20th Oct. 1975

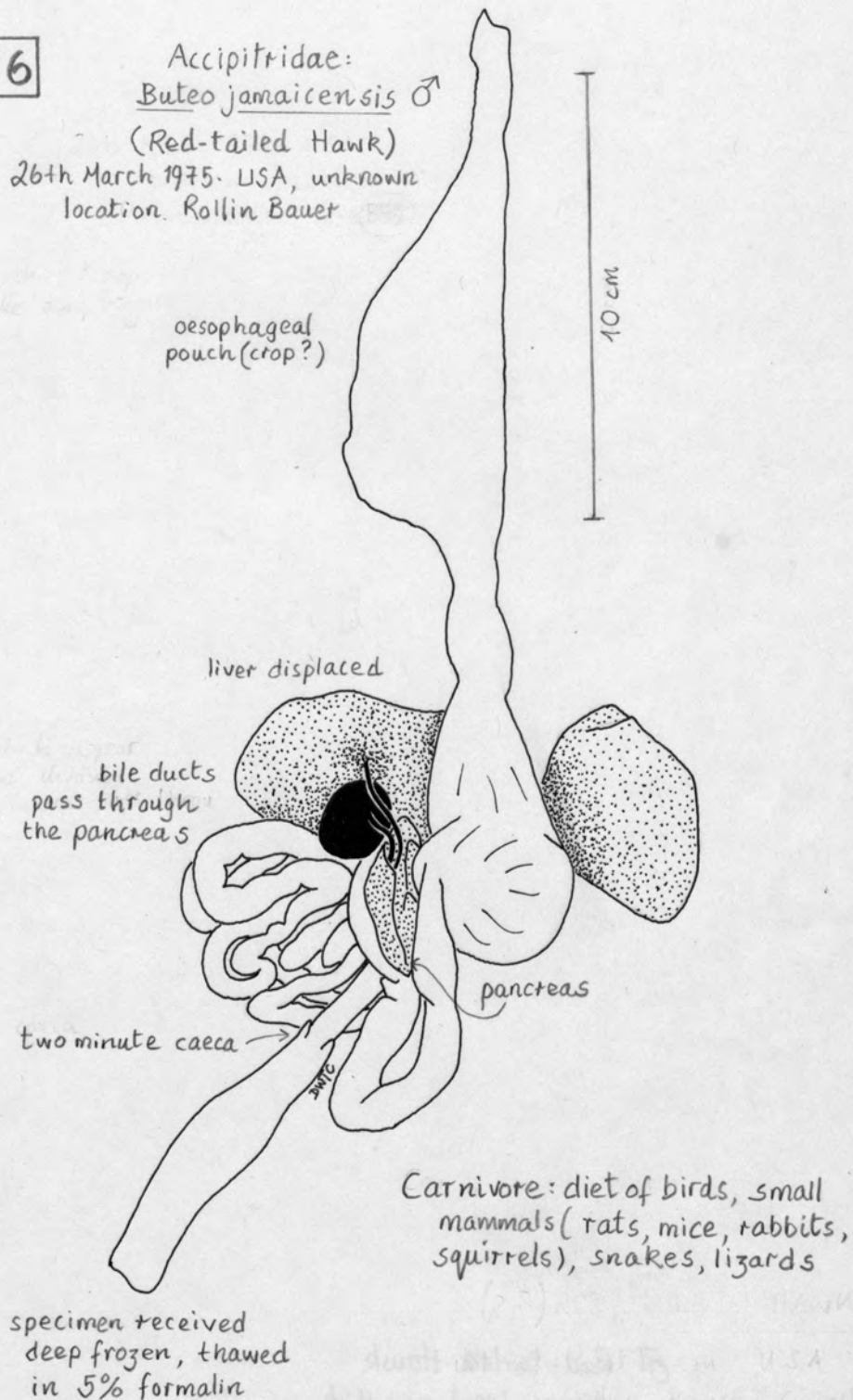
15 *Anas* sp. (Hybrid duck)

16

Accipitridae:  
Buteo jamaicensis ♂

(Red-tailed Hawk)

26th March 1975. USA, unknown  
location. Rollin Bauer



16 *Buteo jamaicensis* (Red-tailed Hawk)

17

Accipitridae:

Buteo buteo

(Common Buzzard)

26th July 1973. Falconry  
Centre, UK

prominent  
oesophageal pouch

10 cm

liver displaced

both bile ducts  
pass through the  
pancreas

small ventriculus

pancreas

Is this length a  
post-mortem effect?

two minute caeca

specimen examined  
48 h after death

Carnivore: diet of small mammals and birds

17 *Buteo buteo* (Common Buzzard)



18

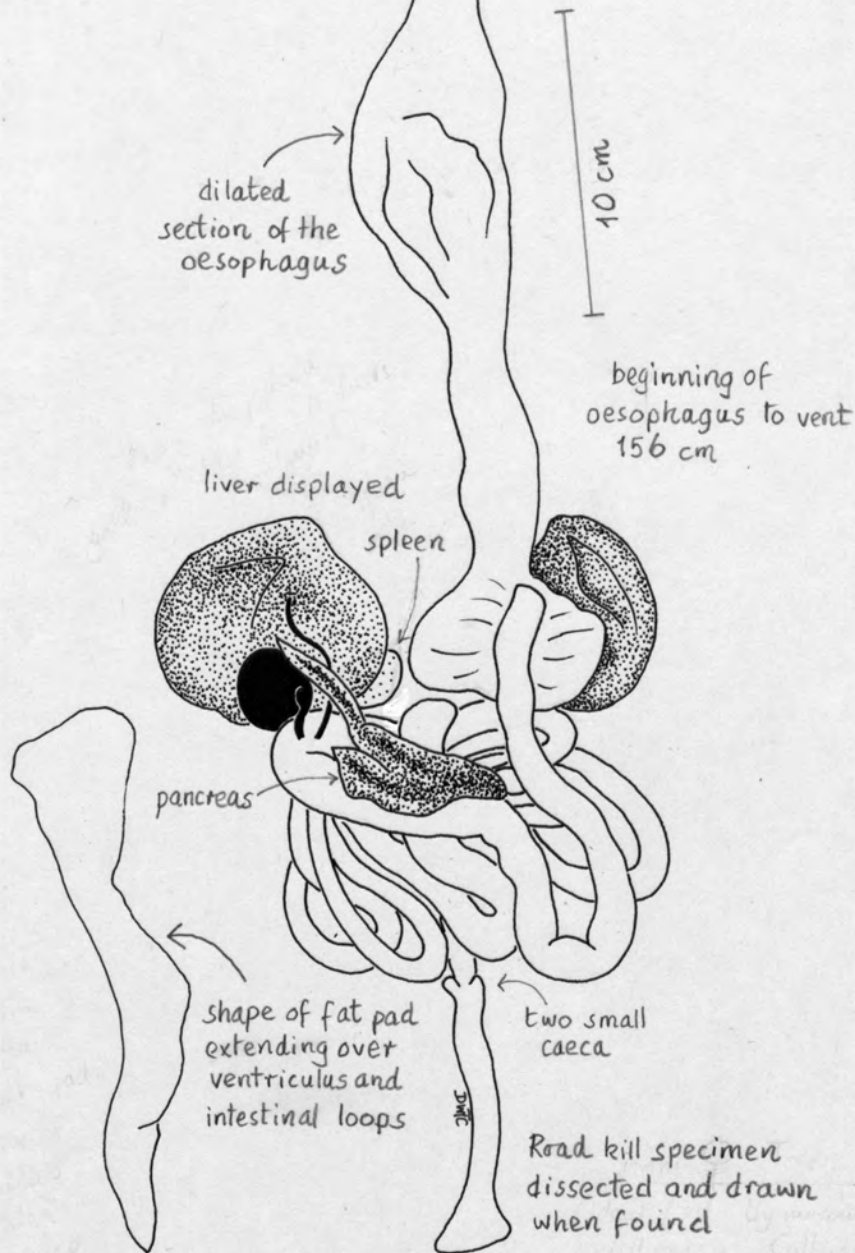
Accipitridae:

Aquila rapax ♀

(Tawny Eagle)

5th July 1976 · Nanyuki, Kenya

DWT Crompton



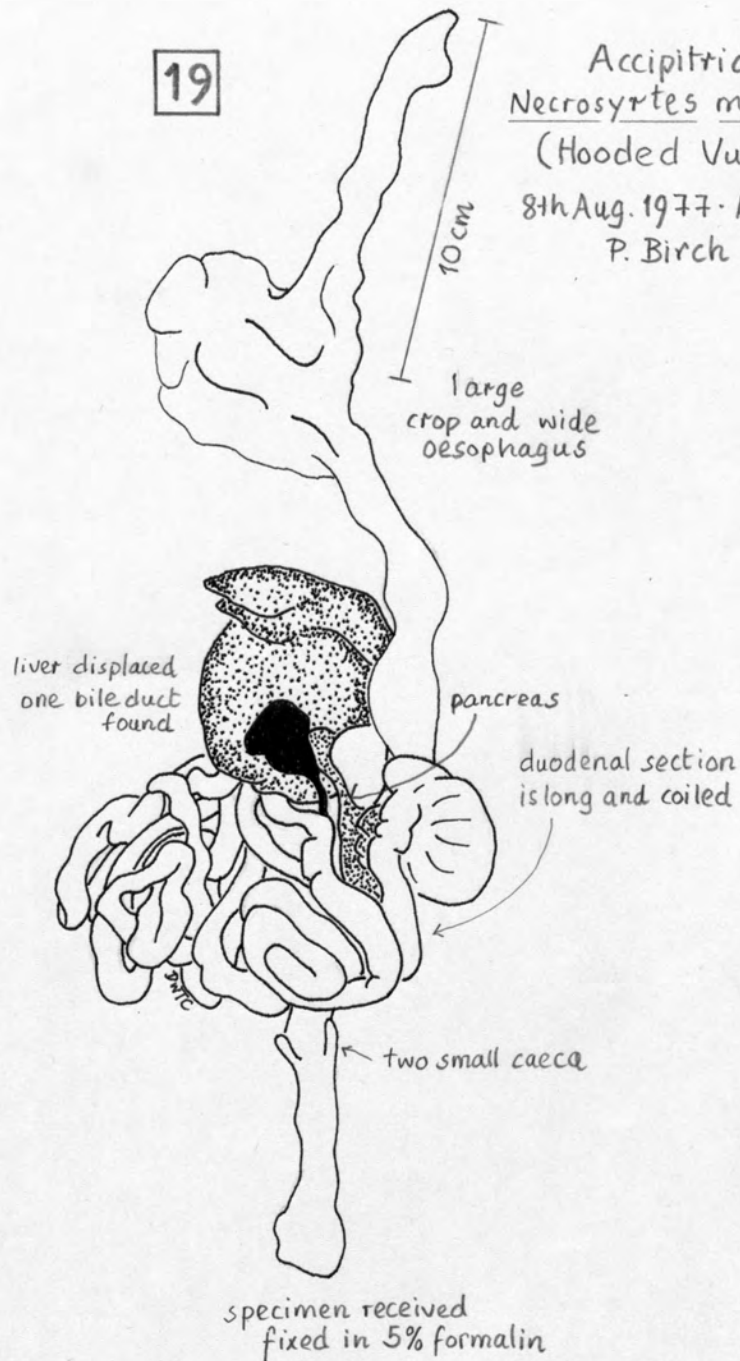
Opportunistic carnivore: diet supplemented  
through kleptoparasitism (Brown, 1976)

18 *Aquila rapax* (Tawny Eagle)

19

Accipitridae:  
*Necrosyrtes monarchus* ♂  
(Hooded Vulture)

8th Aug. 1977 · Moru Ethez, Kenya  
P. Birch



Feed mainly on carrion - feed rapidly, hence the large crop

Falconidae:  
*Falco mexicanus* ♂  
 (Prairie Falcon)  
 18th July 1974. Cornell University, NY,  
 Guido Dingerkus USA

20

wide and  
 extensible  
 oesophagus

2 cm

liver  
 displaced

bilobed  
 pancreas

two minute  
 caeca

Carnivore: diet of small  
 mammals (especially ground  
 squirrels) and sometimes birds

specimen received in  
 10% formalin, transferred  
 to 5% formalin

20 *Falco mexicanus* (Prairie Falcon)

21

Falconidae:  
*Falco tinnunculus* ♀  
 (Eurasian Kestrel)  
 15th March 1974. Falconry  
 Centre, UK  
 Glasier

liver displaced

5cm

duodenum  
 wider than  
 rest of the  
 small intestine

coiled

two minute  
 caeca

beginning of oesophagus  
 to vent c. 70cm

"soft" ventriculus

pancreas

outline of  
 the fat pad  
 lying over the  
 ventriculus and  
 duodenum

specimen received fresh  
 fixed in 5% formalin

Carnivore: diet of mice, voles, shrews

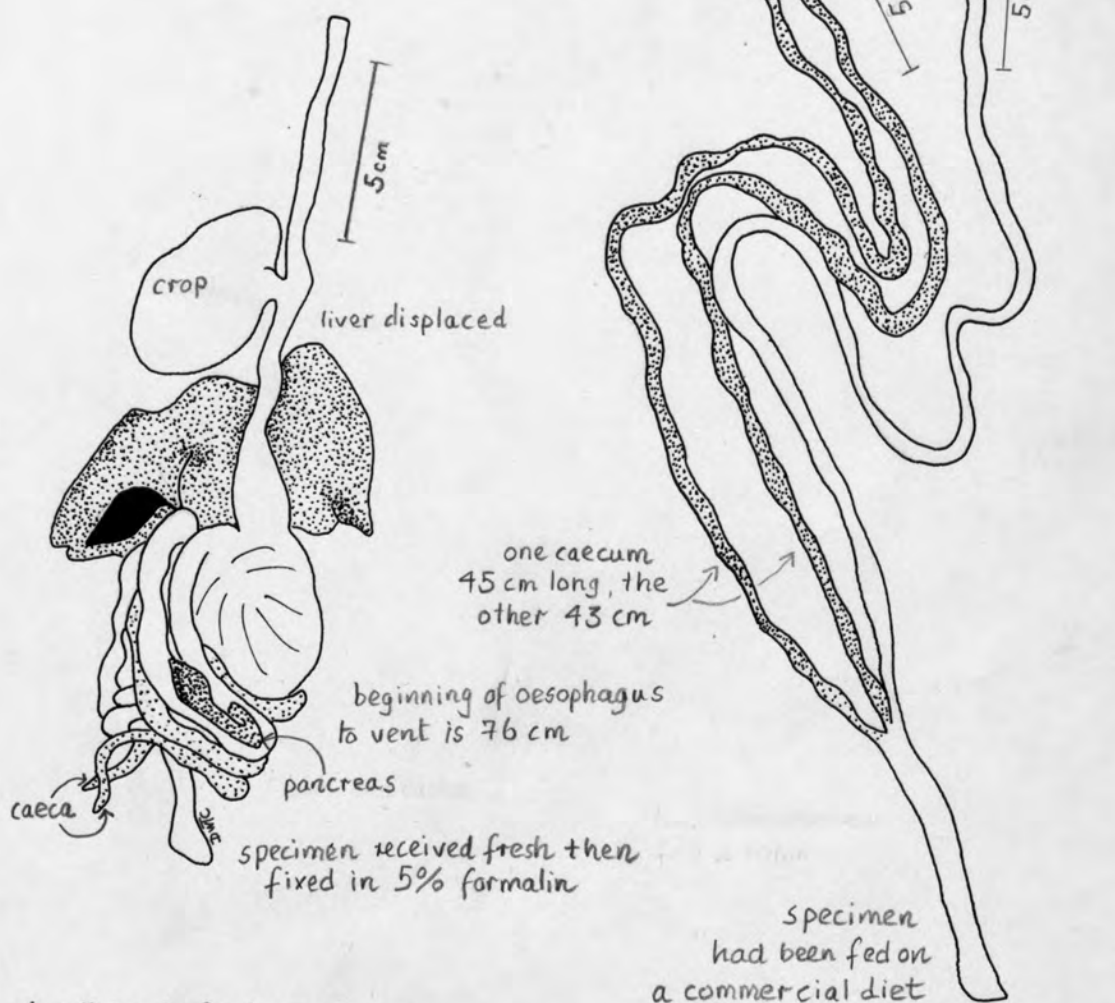
22

Tetraonidae: Lagopus scoticus ♀  
(Red Grouse - captive)\*

24th July 1974

Banchory Res. Stn, Scotland

Robert Moss



Adult birds feed mainly on shoots of young heather (Calluna sp.) other plants are eaten if heather is of poor quality. Chicks rely on insects for food (Leslie & Shipley, 1912).

\* Clements (1974) p. 55  
common name is "Scottish Ptarmigan"

An illustration of the alimentary tract of the Red Grouse is shown opposite p. 166 in Leslie & Shipley (1912).

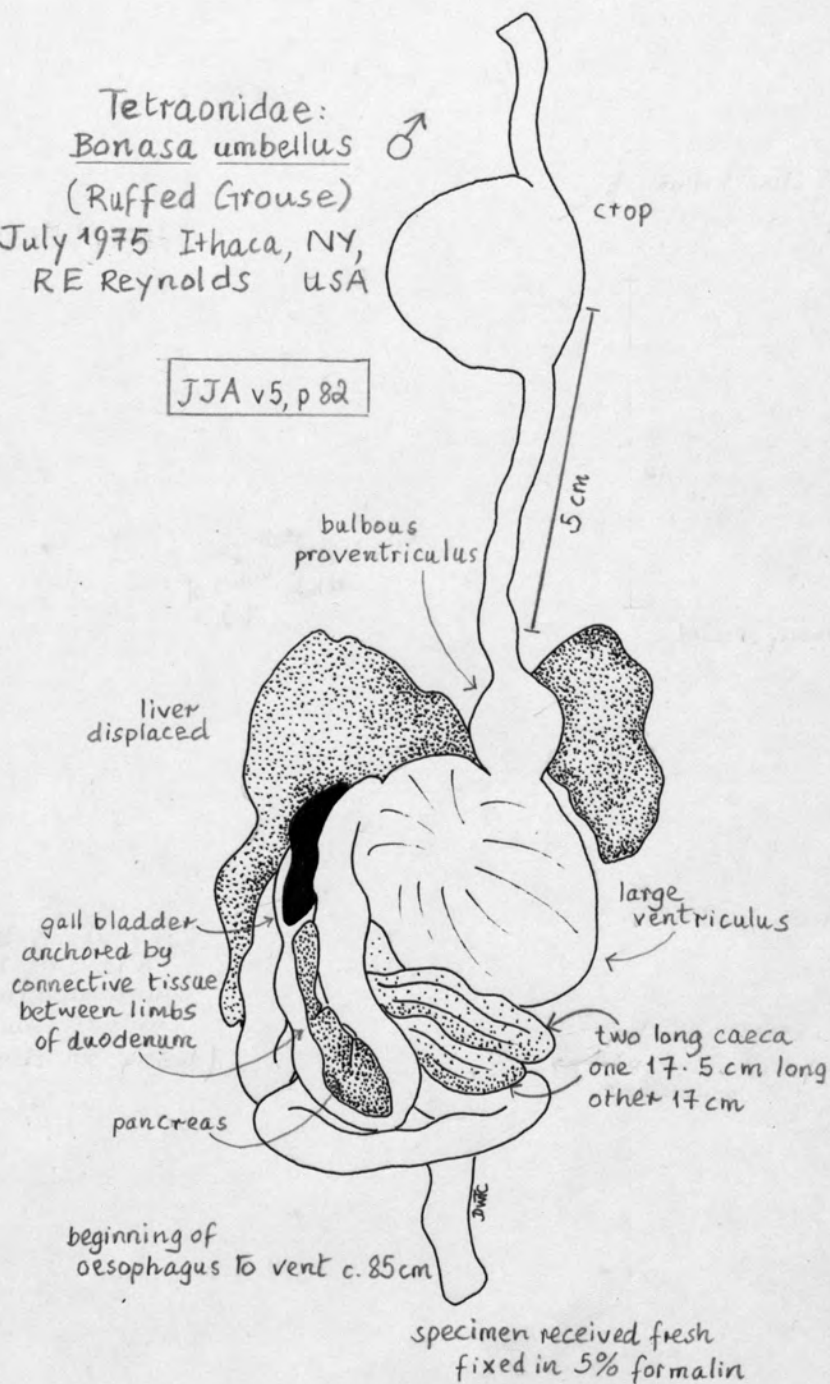
22 Lagopus scoticus (Red Grouse)



Tetraonidae:  
Bonasa umbellus ♂  
 (Ruffed Grouse)  
 9th July 1975 Ithaca, NY,  
 RE Reynolds USA

23

JJA v5, p 82



Vegetarian: seeds and berries of all kinds  
 according to Audubon (see Dover edition, 1967)

Phasianidae:  
Colinus virginianus ♀  
(Bobwhite/Bobwhite Quail)

14th June 1975 · Duchess Co., NY, USA  
Guido Dingerkus

24

extensive  
crop

liver displaced  
and part cut away

5 cm

2 cm

caecum

pancreas

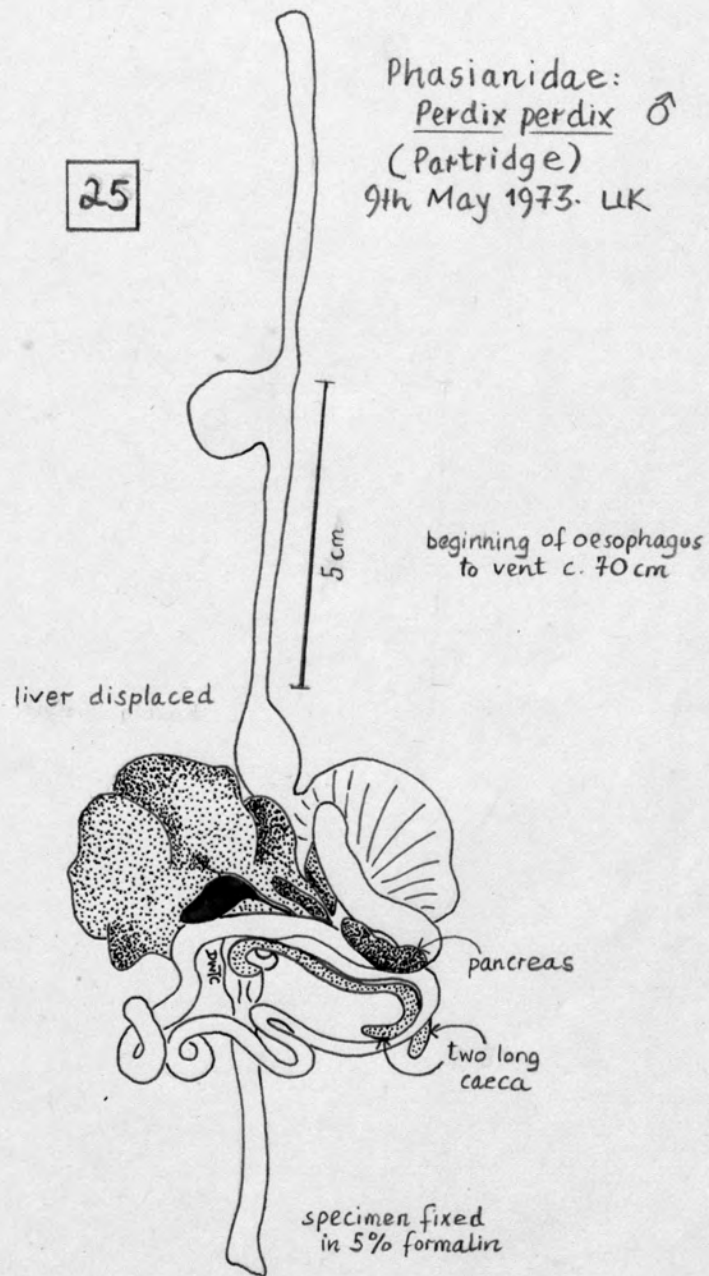
Vegetarian: seeds

specimen received 26th June 1975  
in 10% formalin, transferred  
to 5% formalin

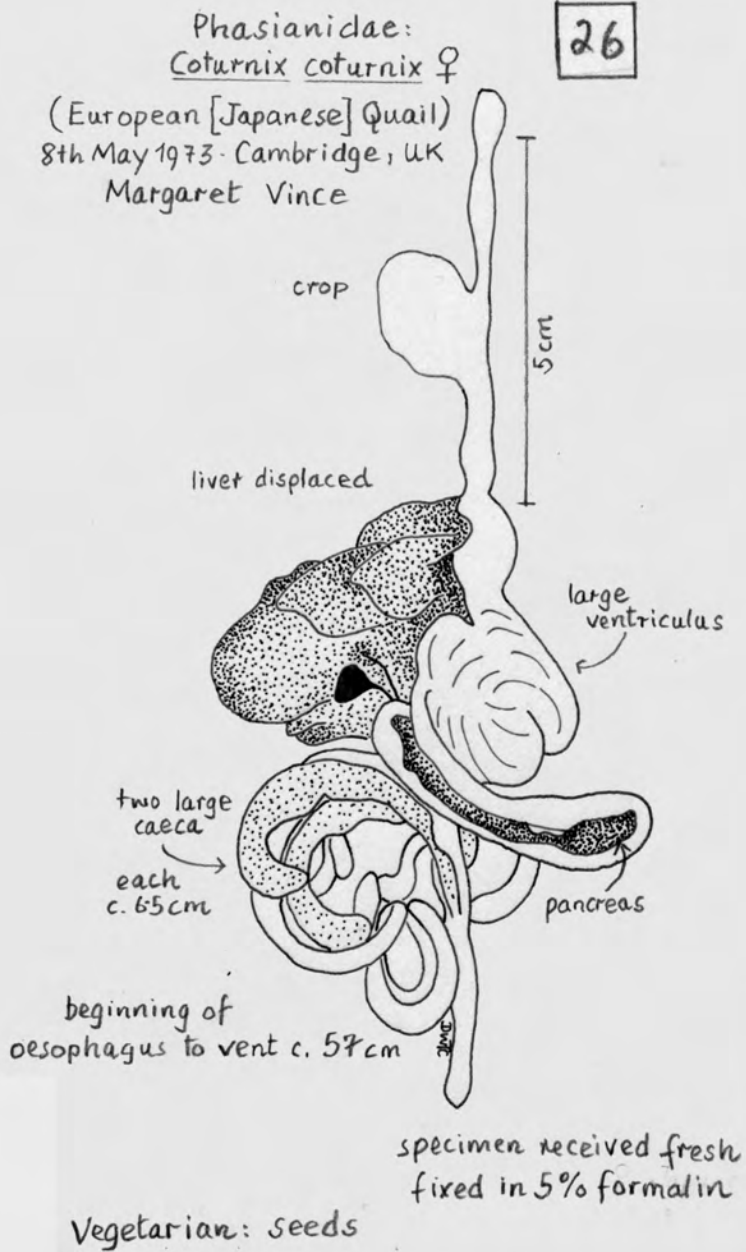
24 *Colinus virginianus* (Bobwhite/Bobwhite Quail)

25

Phasianidae:  
Perdix perdix ♂  
(Partridge)  
9th May 1973. UK



Omnivore: diet of seeds, leaves and insects

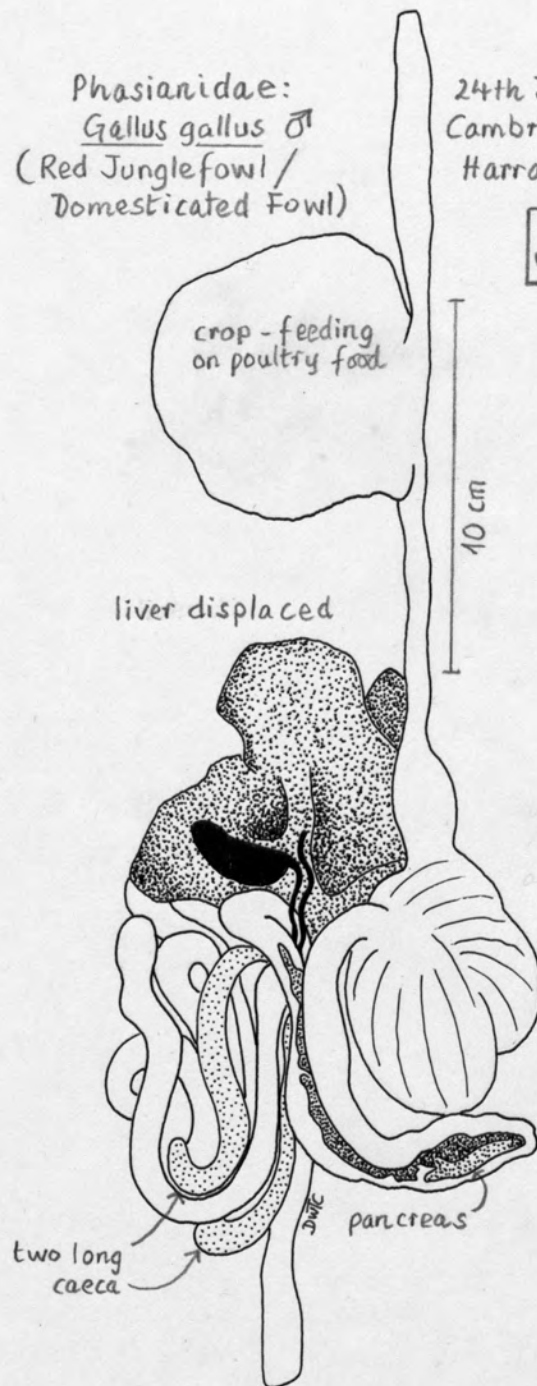


26 *Coturnix coturnix* (European [Japanese] Quail)

Phasianidae:  
Gallus gallus ♂  
(Red Junglefowl /  
Domesticated Fowl)

24th Jan. 1974  
Cambridge, UK  
Harradine

27



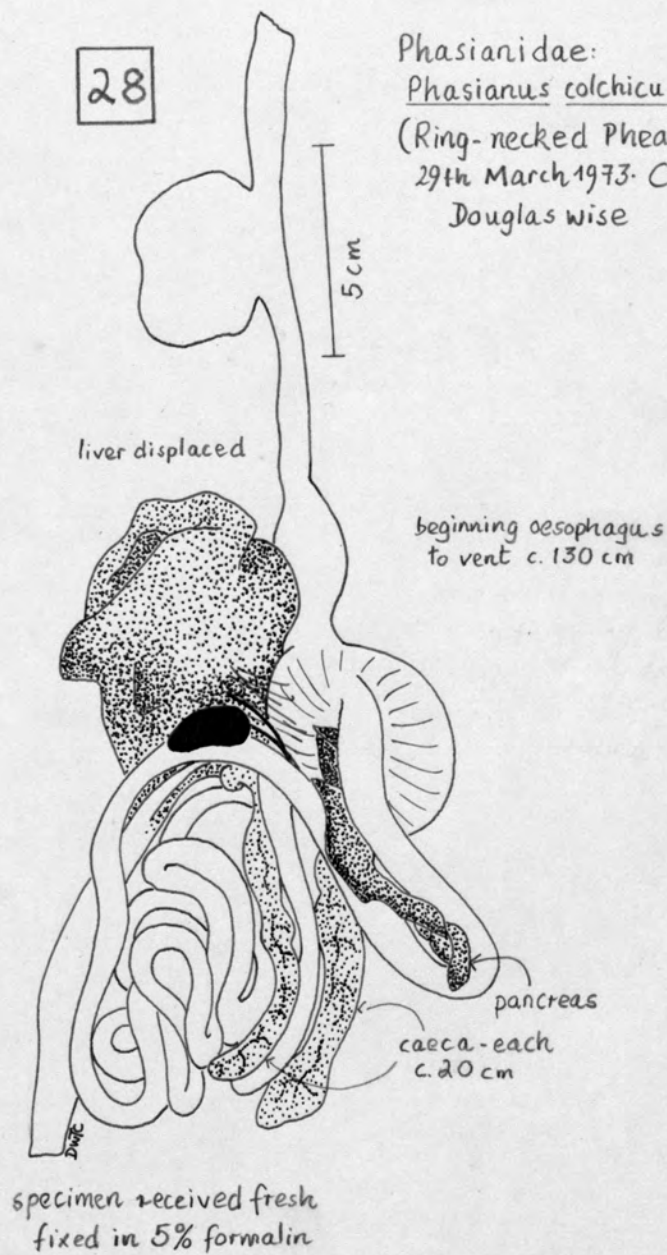
specimen examined fresh

In nature feed on seeds, fruits, insects



28

Phasianidae:  
Phasianus colchicus ♂  
(Ring-necked Pheasant)  
29th March 1973. Cambridge, UK  
Douglas Wise



Vegetarian: feed on the ground; diet of seeds,  
fruits, plants - also take invertebrates

28 *Phasianus colchicus* (Ring-necked Pheasant)

29

Phasianidae:  
*Pavo cristatus* ♂  
(Peacock/Pea Fowl)

17th March 1973: Sharnbrook, Beds, UK  
Kenneth Hill

beginning of oesophagus  
to vent c. 150 cm

10 cm

liver  
displaced

two large caeca

pancreas

Omnivore: diet of seeds,  
plant parts, insects,  
amphibians, reptiles

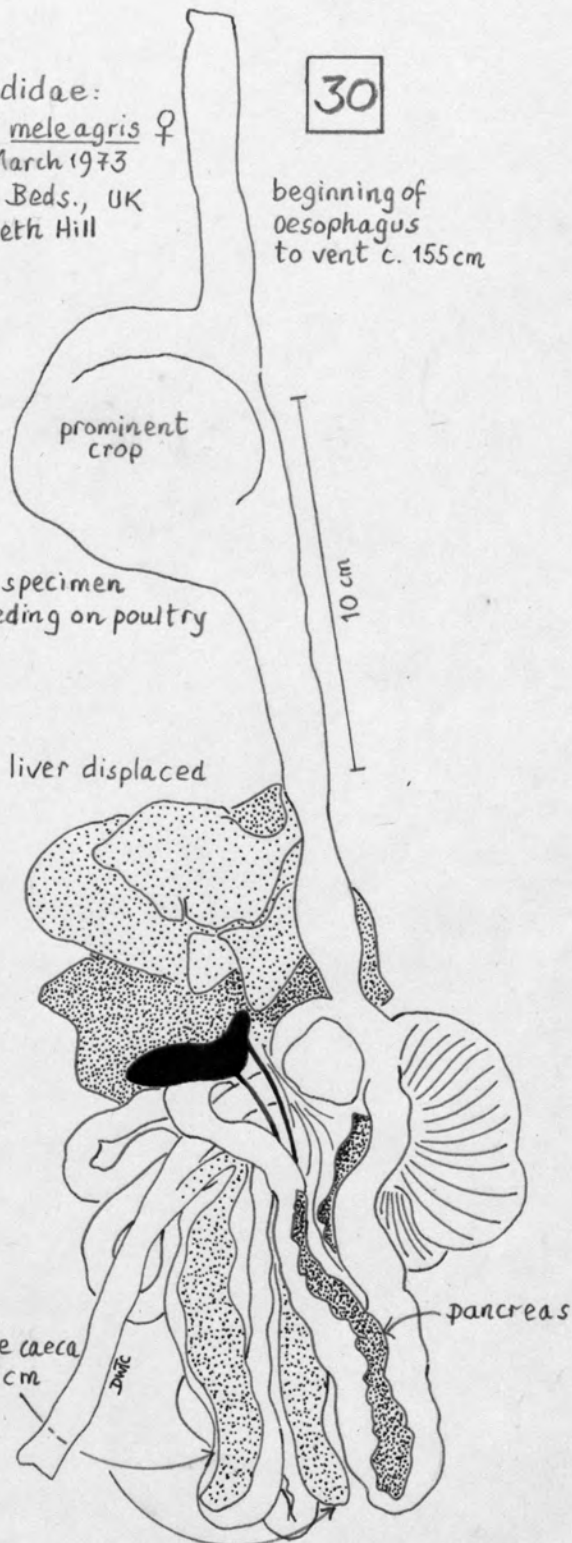
fresh specimen  
fixed 5% formalin

29 *Pavo cristatus* (Common Peafowl/Peacock)

Numididae:  
*Numida meleagris* ♀  
 12th March 1973  
 Sharnbrook, Beds., UK  
 Kenneth Hill

30

beginning of  
 oesophagus  
 to vent c. 155 cm



this specimen  
 was feeding on poultry  
 food

liver displaced

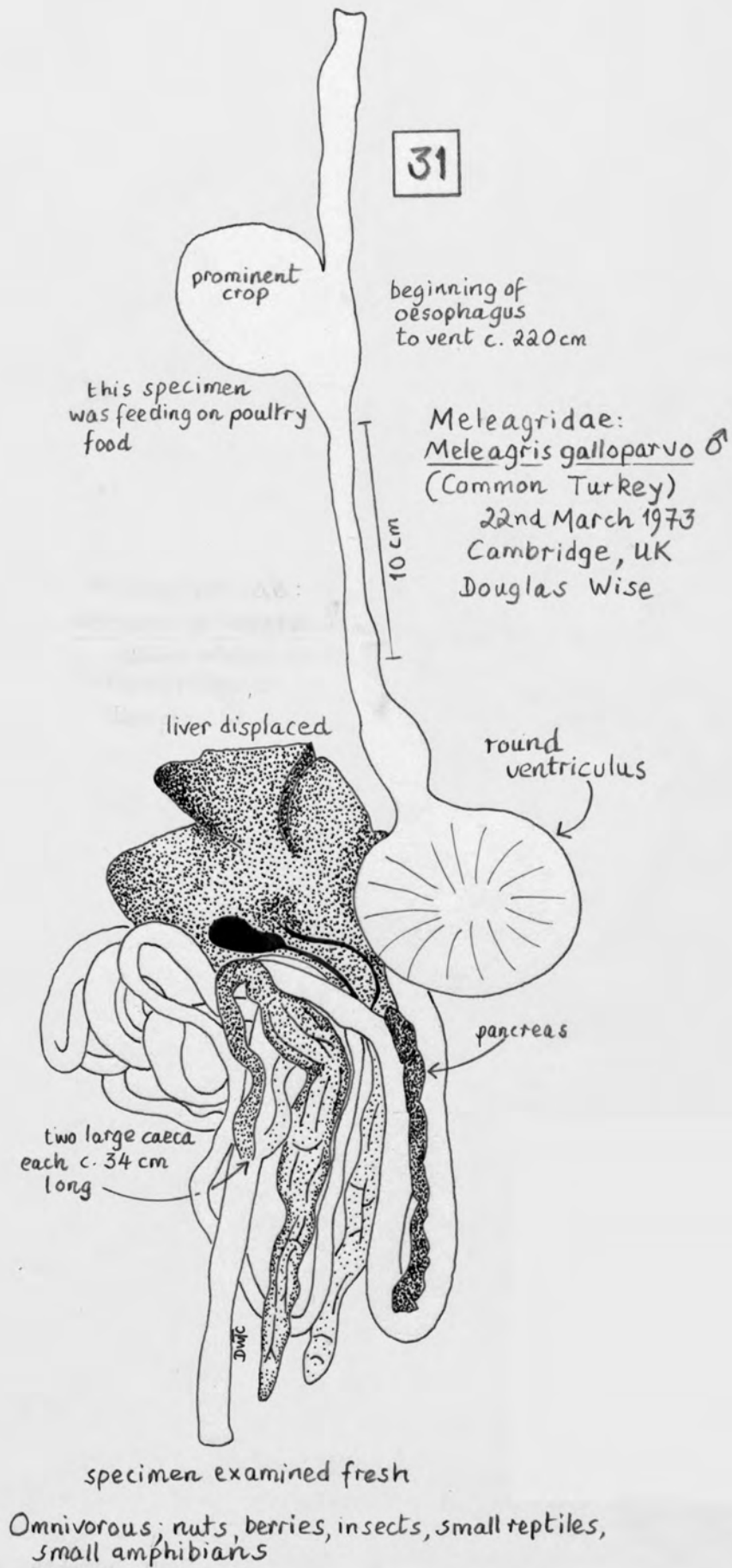
two large caeca  
 each c. 20 cm  
 long

pancreas

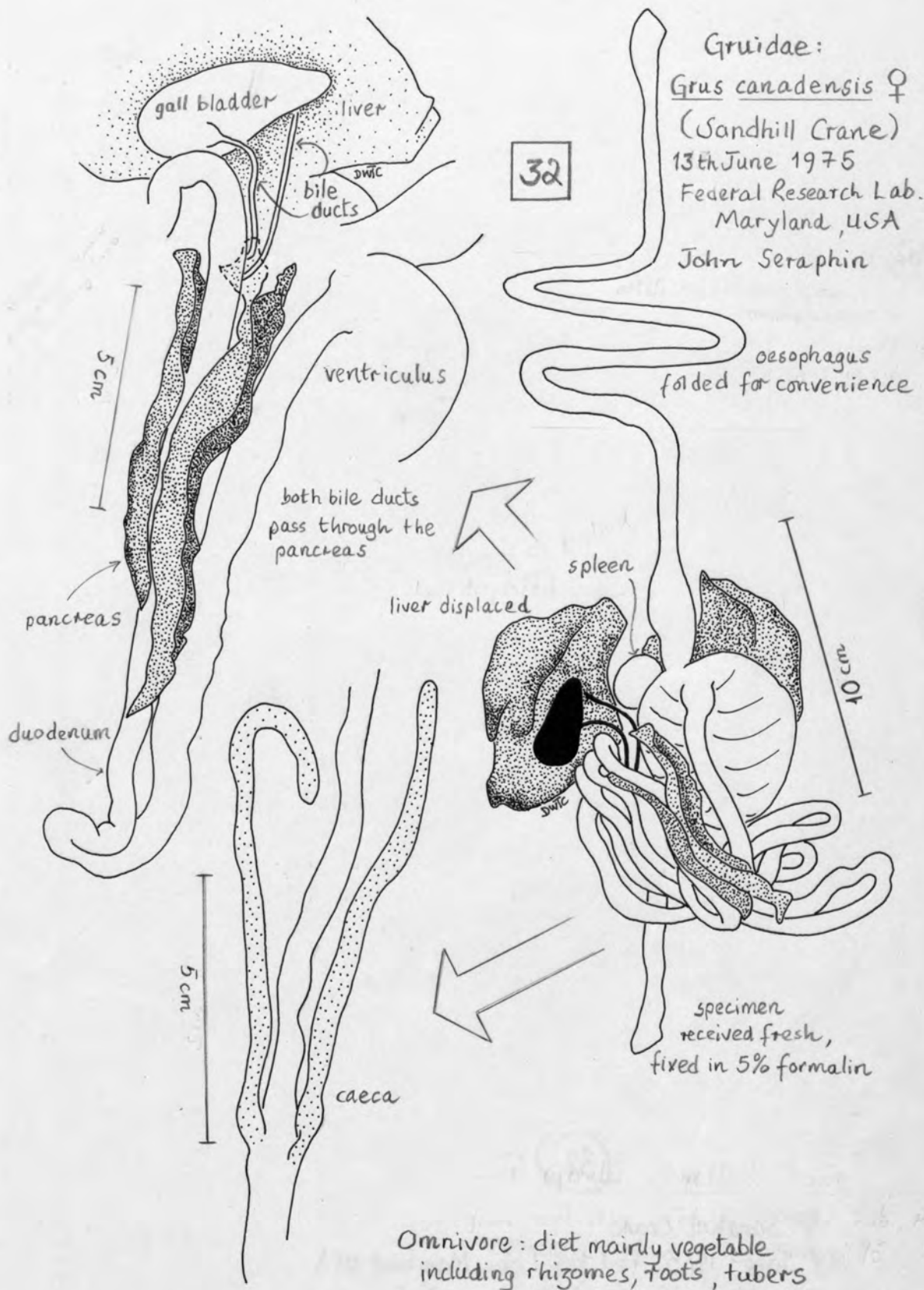
specimen examined fresh

In nature; scavenge on ground insects, maggots, carcasses

30 *Numida meleagris* (Tufted Guinea fowl)



31 *Meleagris gallopavo* (Common Turkey)



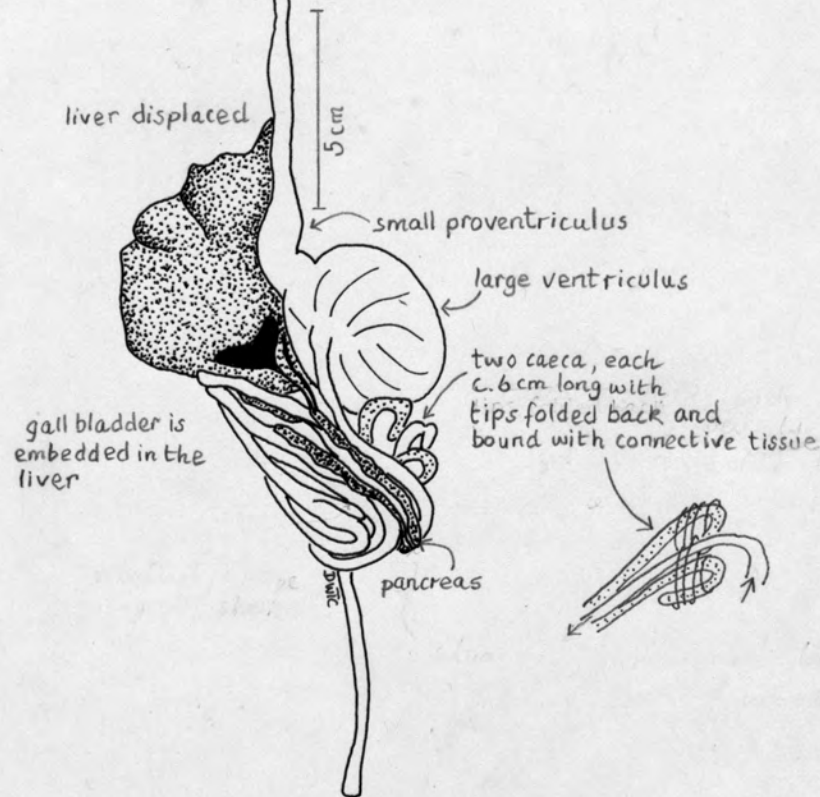
32 *Grus canadensis* (Sandhill Crane)



Rallidae:  
*Gallinula chloropus* ♂  
 (Moorhen)  
 14th Feb. 1974. Hengrave  
 Suffolk, UK  
 J. Johnstone

33

beginning of oesophagus  
 to vent c. 65 cm

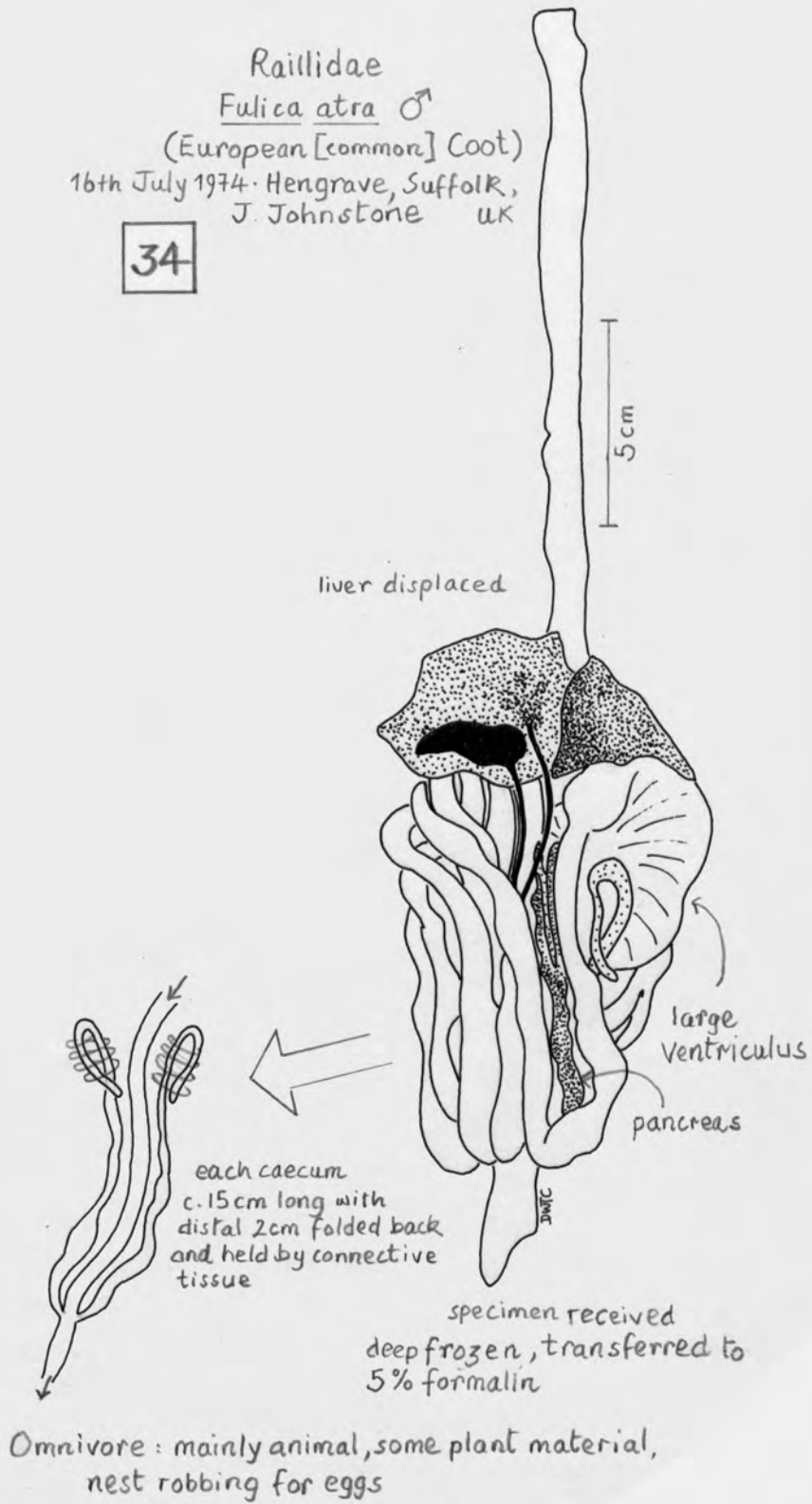


specimen fixed in 5% formalin

Omnivorous; feeds on plant material, amphibians,  
 small rodents, eggs

Rallidae  
*Fulica atra* ♂  
 (European [common] Coot)  
 16th July 1974 · Hengrave, Suffolk,  
 J. Johnstone UK

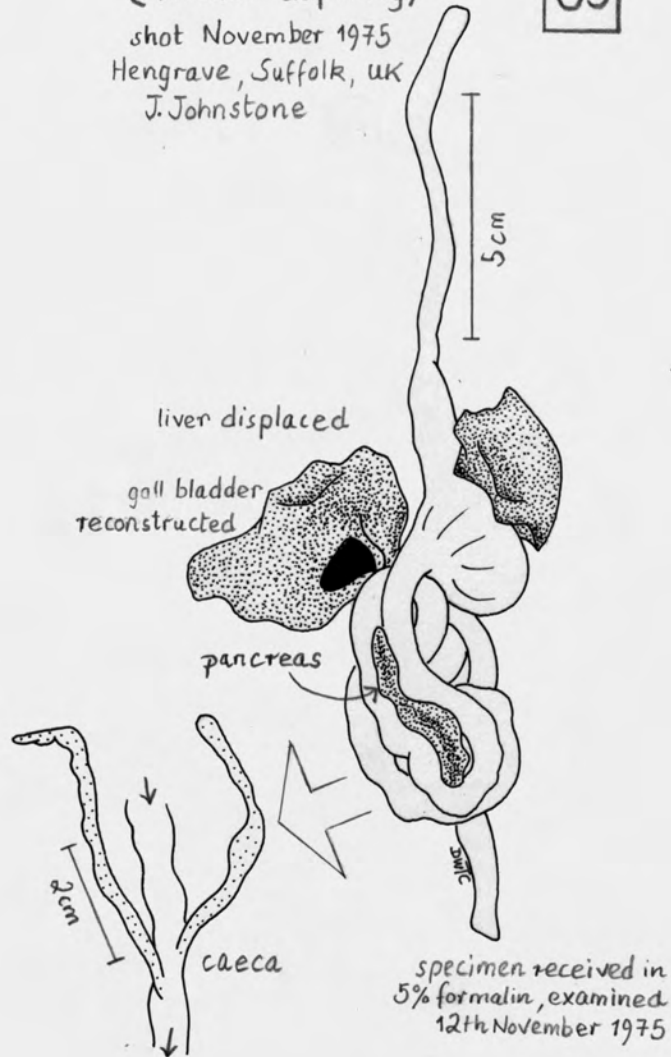
34



34 *Fulica atra* (Coot)

Charadriidae:  
Vanellus vanellus ♀  
 (Northern Lapwing)  
 shot November 1975  
 Hengrave, Suffolk, UK  
 J. Johnstone

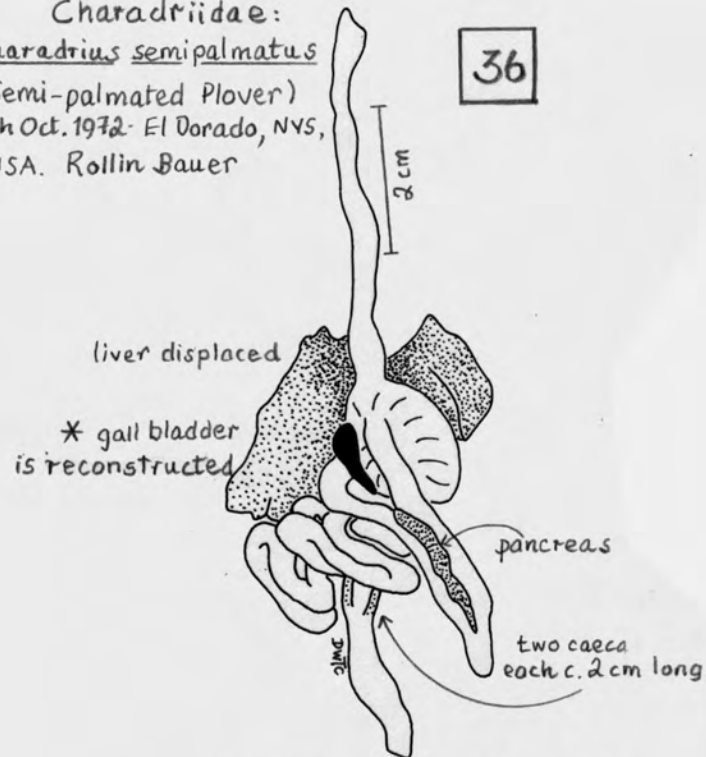
35



Forages on ground for earthworms,  
 insect larvae, beetles

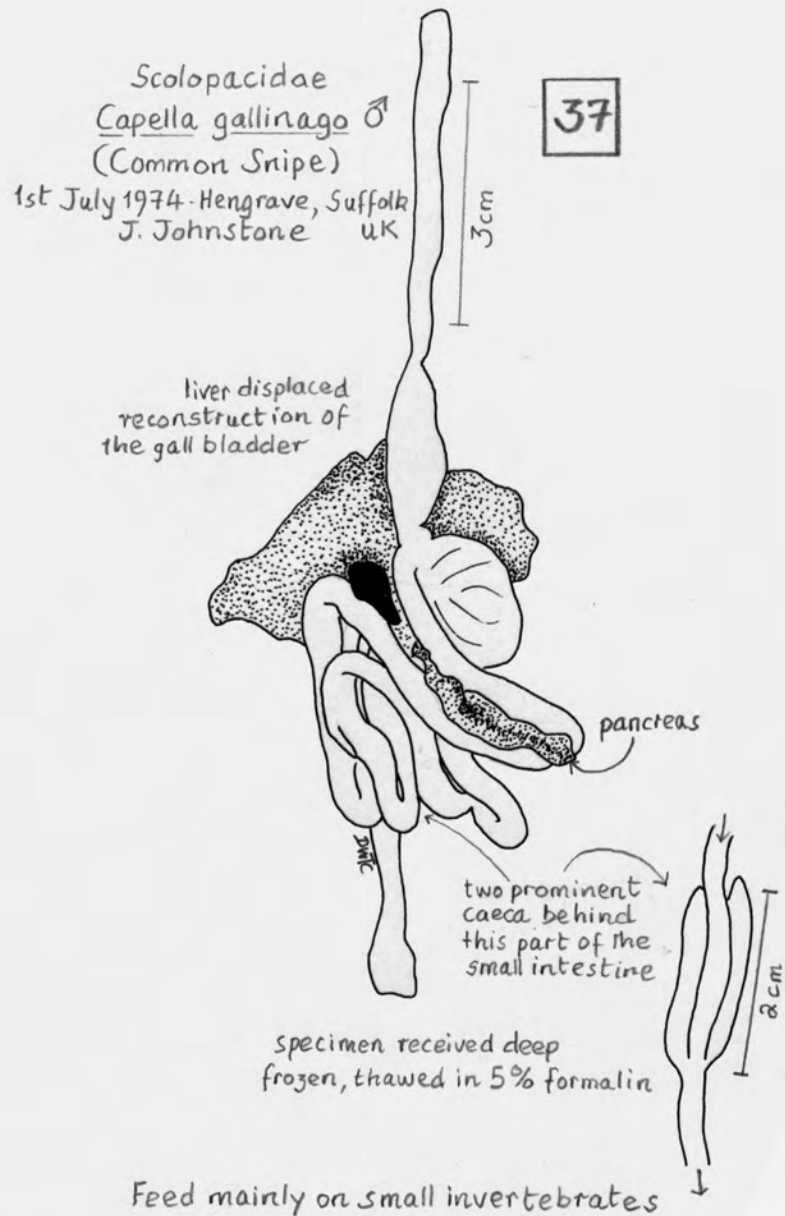
Charadriidae:  
Charadrius semipalmatus  
 (Semi-palmated Plover)  
 15th Oct. 1972 - El Dorado, NYS,  
 USA. Rollin Bauer

36



specimen received deep frozen  
 thawed in 5% formalin  
 [\* in a poor state of preservation]  
 19th March 1975

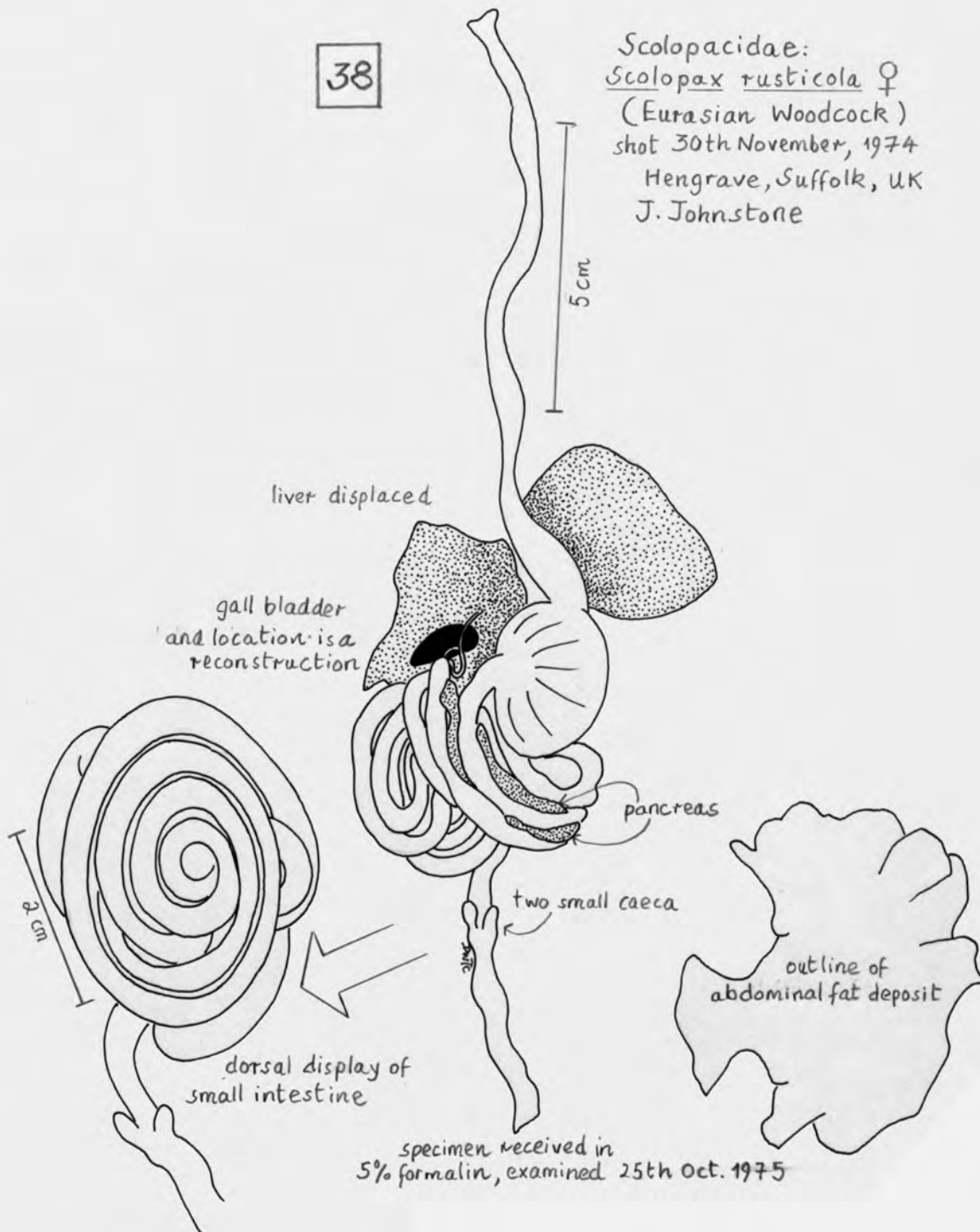
Feed on insects, crustaceans, worms





38

Scolopacidae:  
*Scolopax rusticola* ♀  
 (Eurasian Woodcock)  
 shot 30th November, 1974  
 Hengrave, Suffolk, UK  
 J. Johnstone



Carnivore: diet includes earthworms,  
 variety of insects, occasionally plant material

38 *Scolopax rusticola* (Eurasian Woodcock)

39

oesophagus seems  
capable of much  
extension

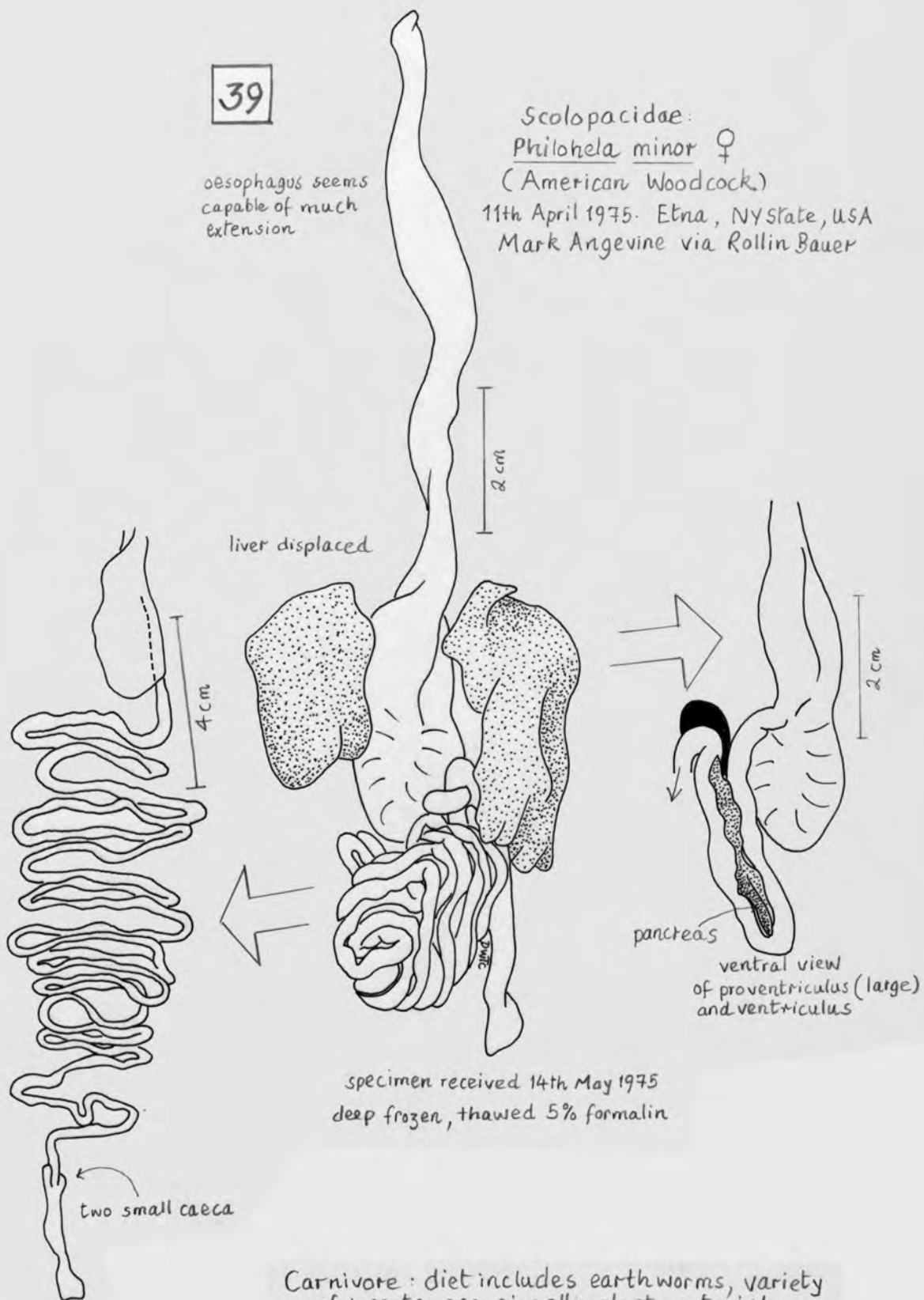
Scolopacidae:

*Philohela minor* ♀

(American Woodcock)

11th April 1975. Etna, NY State, USA

Mark Angevine via Rollin Bauer

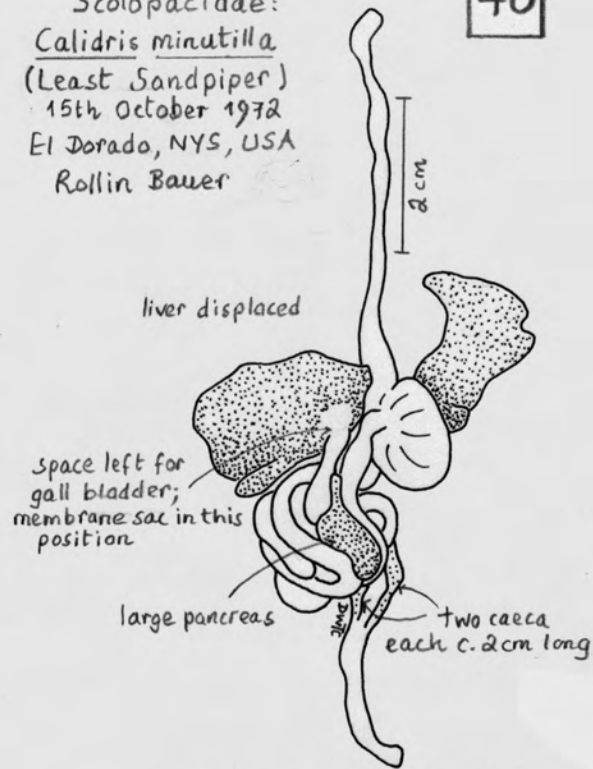


specimen received 14th May 1975  
deep frozen, thawed 5% formalin

Carnivore: diet includes earthworms, variety  
of insects, occasionally plant material

Scolopacidae:  
*Calidris minutilla*  
 (Least Sandpiper)  
 15th October 1972  
 El Dorado, NYS, USA  
 Rollin Bauer

40

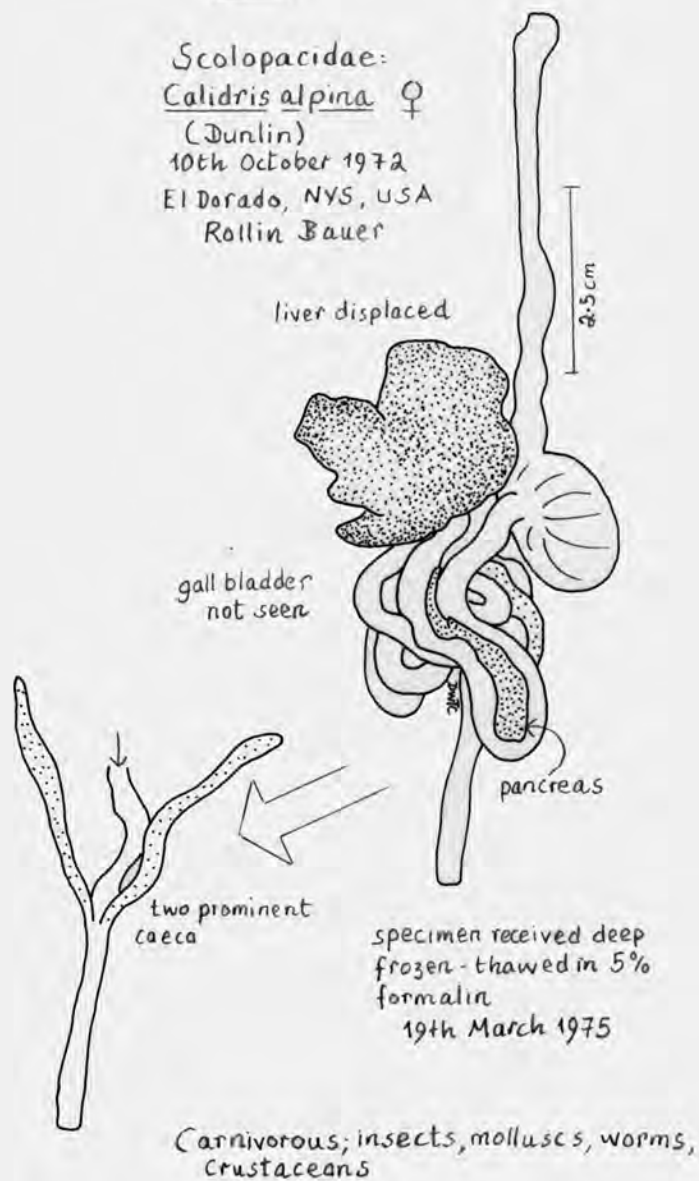


specimen received deep frozen  
 thawed in 5% formalin  
 19th March 1975

Foraging for small crustaceans, insects,  
 small molluscs

41

Scolopacidae:  
*Calidris alpina* ♀  
 (Dunlin)  
 10th October 1972  
 El Dorado, NYS, USA  
 Rollin Bauer



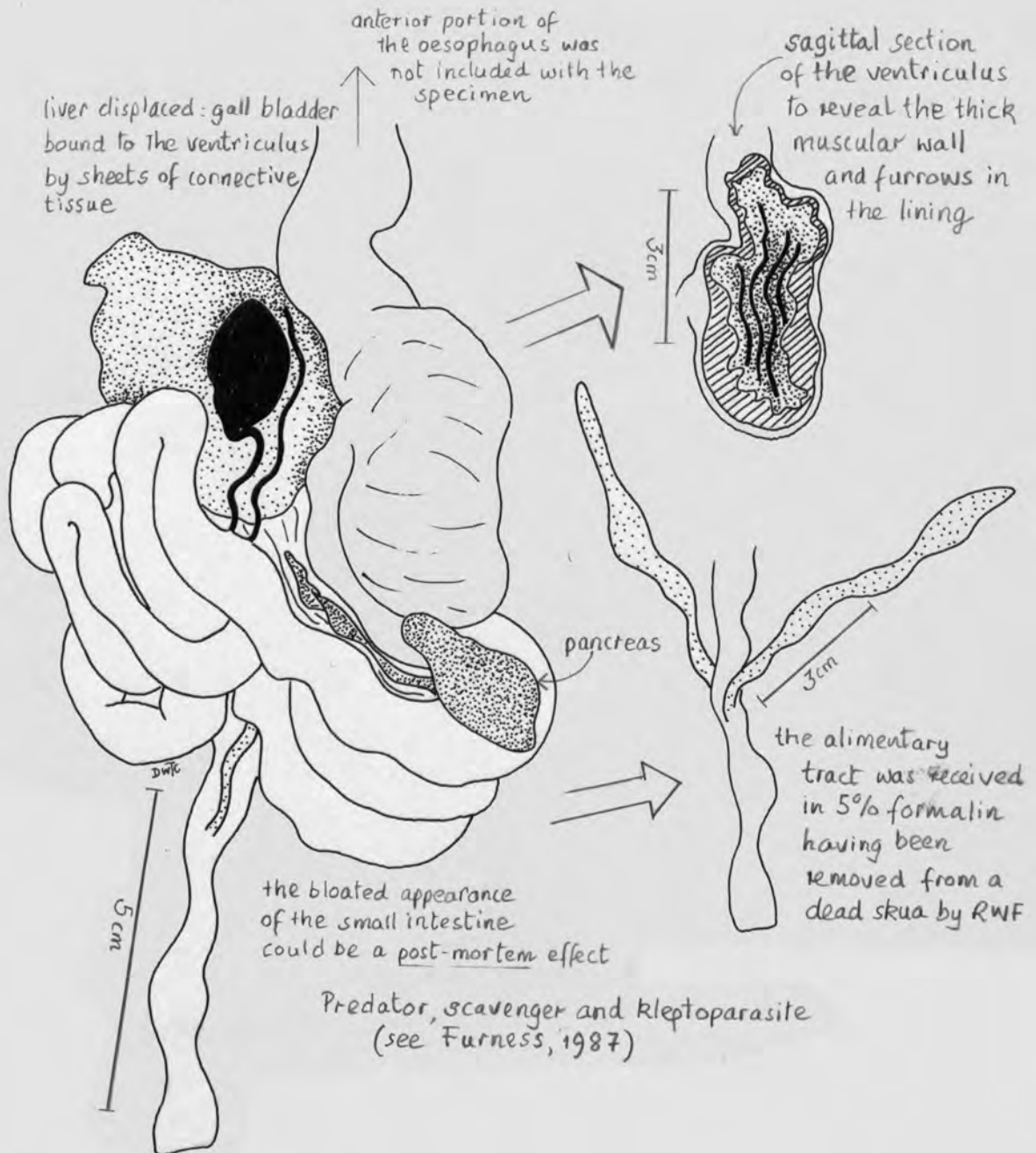
42

Stercorariidae: Catharacta skua

(Great Skua "Bonxie")

Summer 1974 · Foula, Shetland, Scotland

R W Furness

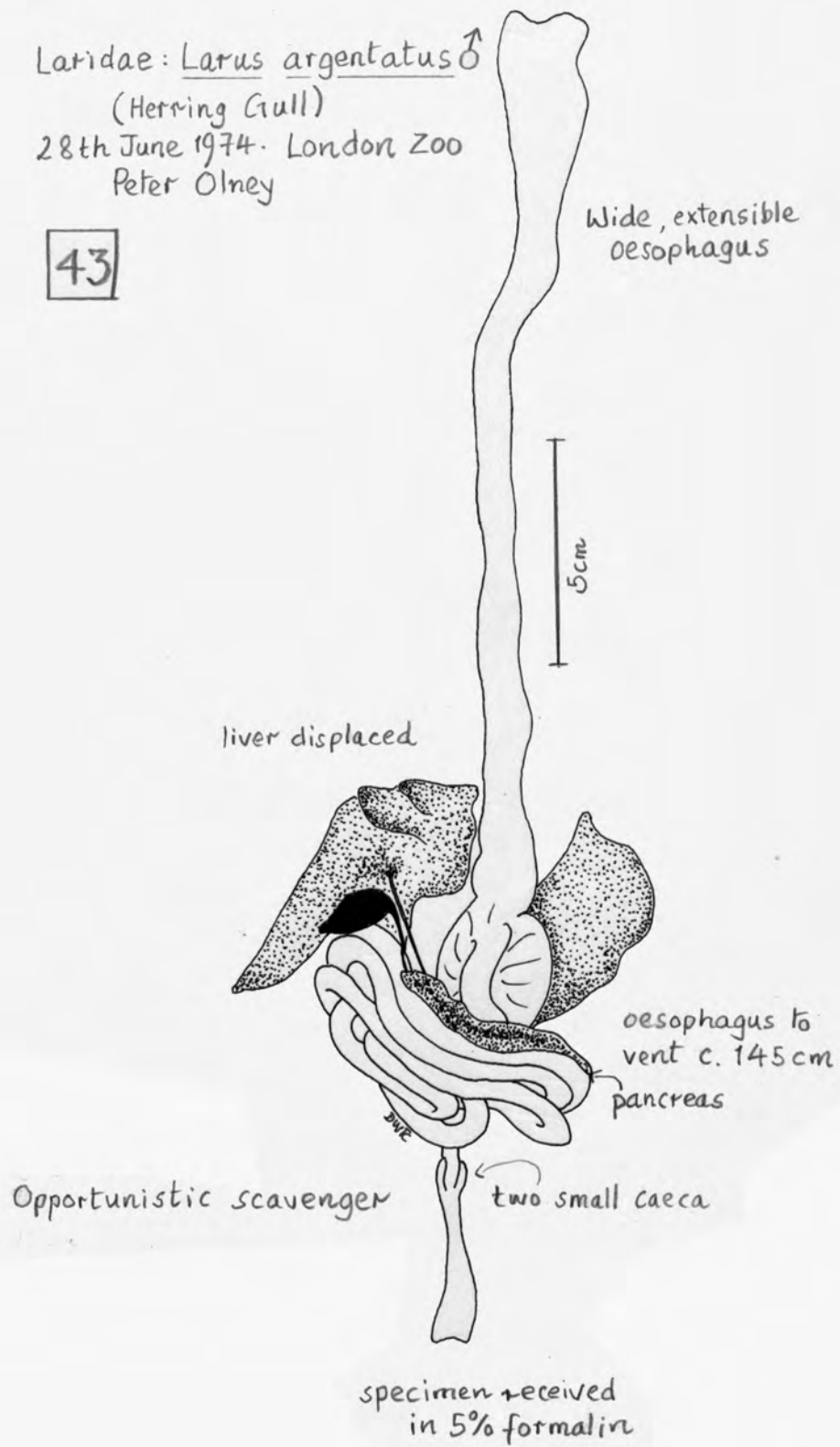


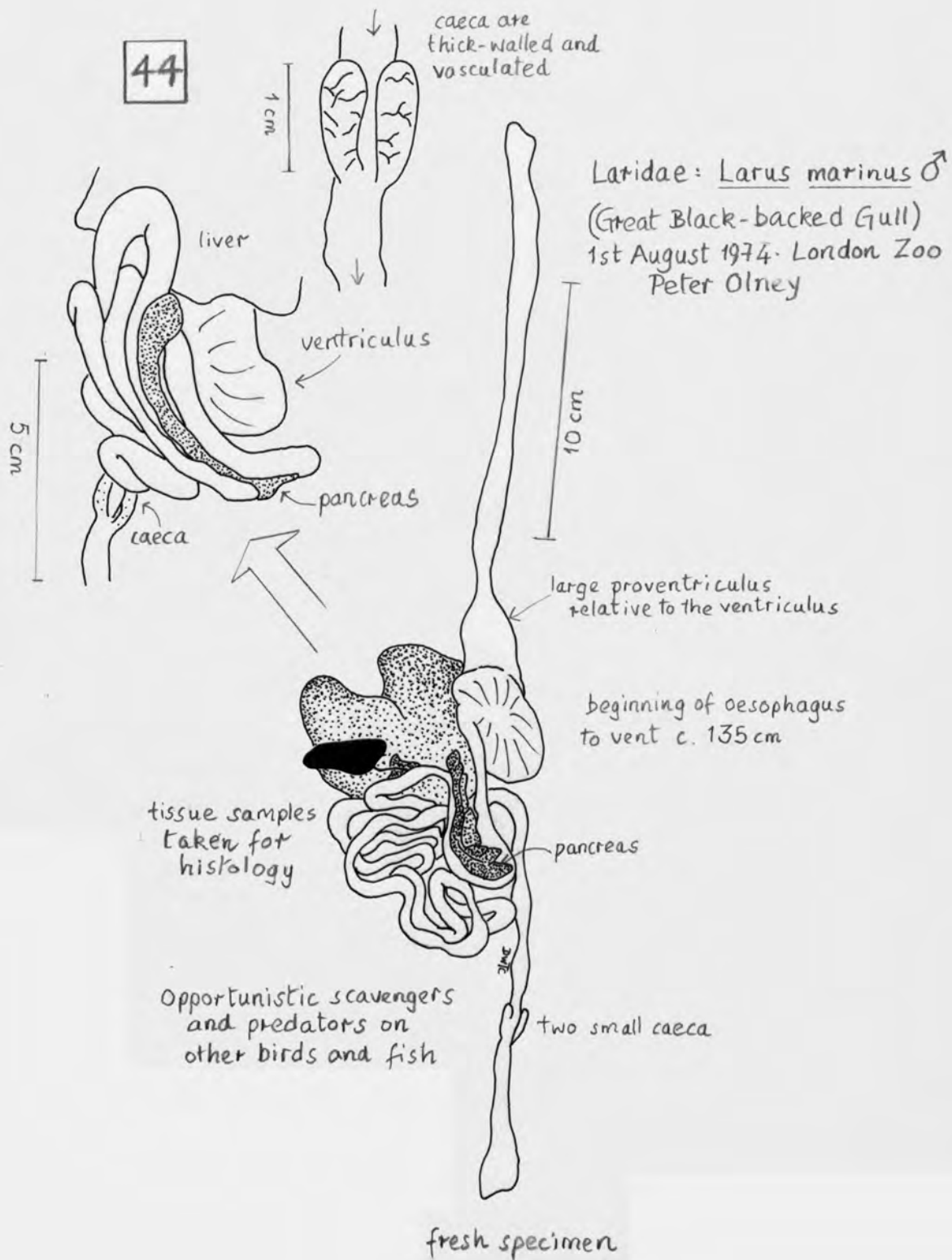
42 *Catharacta skua* (Great Skua "Bonxie")



Laridae: Larus argentatus ♂  
 (Herring Gull)  
 28th June 1974. London Zoo  
 Peter Olney

43





44 *Larus marinus* (Great Black-backed Gull)

45

Laridae: Larus ridibundus ♀  
(Black-headed Gull)  
19th June 1974. Bury, Lancashire, UK  
Mrs Zalasiewicz, Owl Sanctuary

liver displaced

5 cm

pancreas

two small  
caeca

Scavenger: diet of fish,  
worms, insects, carrion

specimen received  
in 5% formalin

46

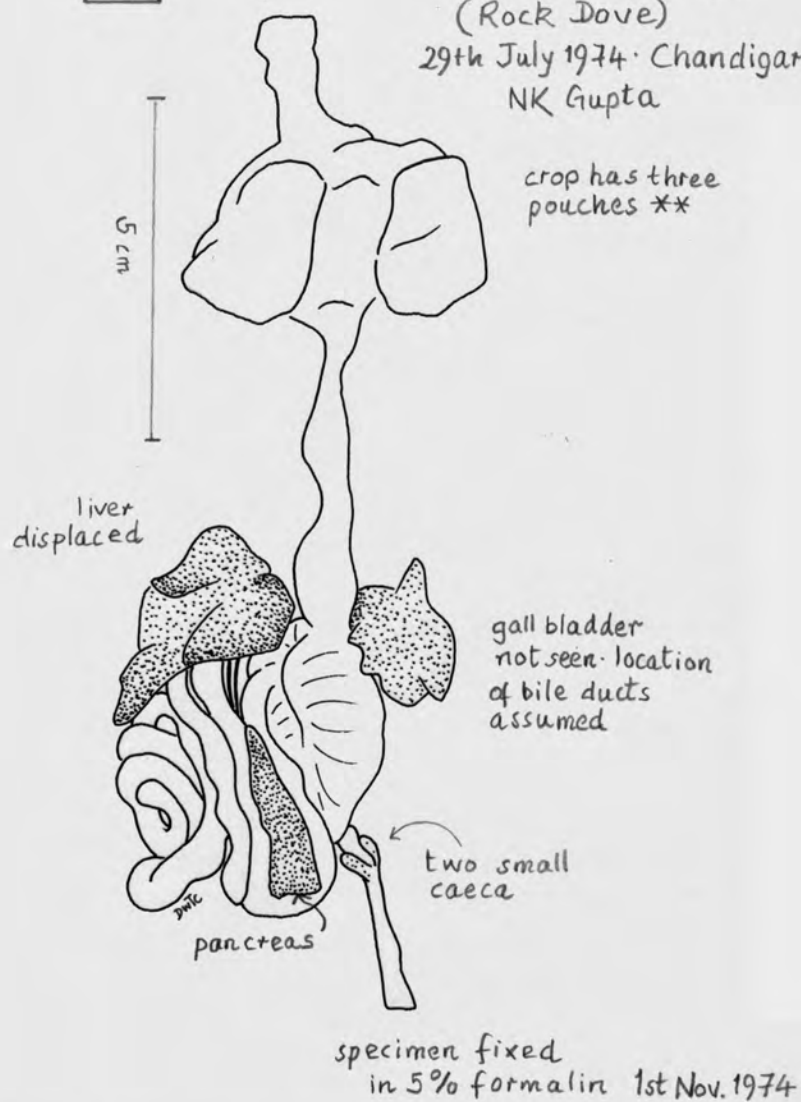
Columbidae:

*Columba livia* ♀ \*

(Rock Dove)

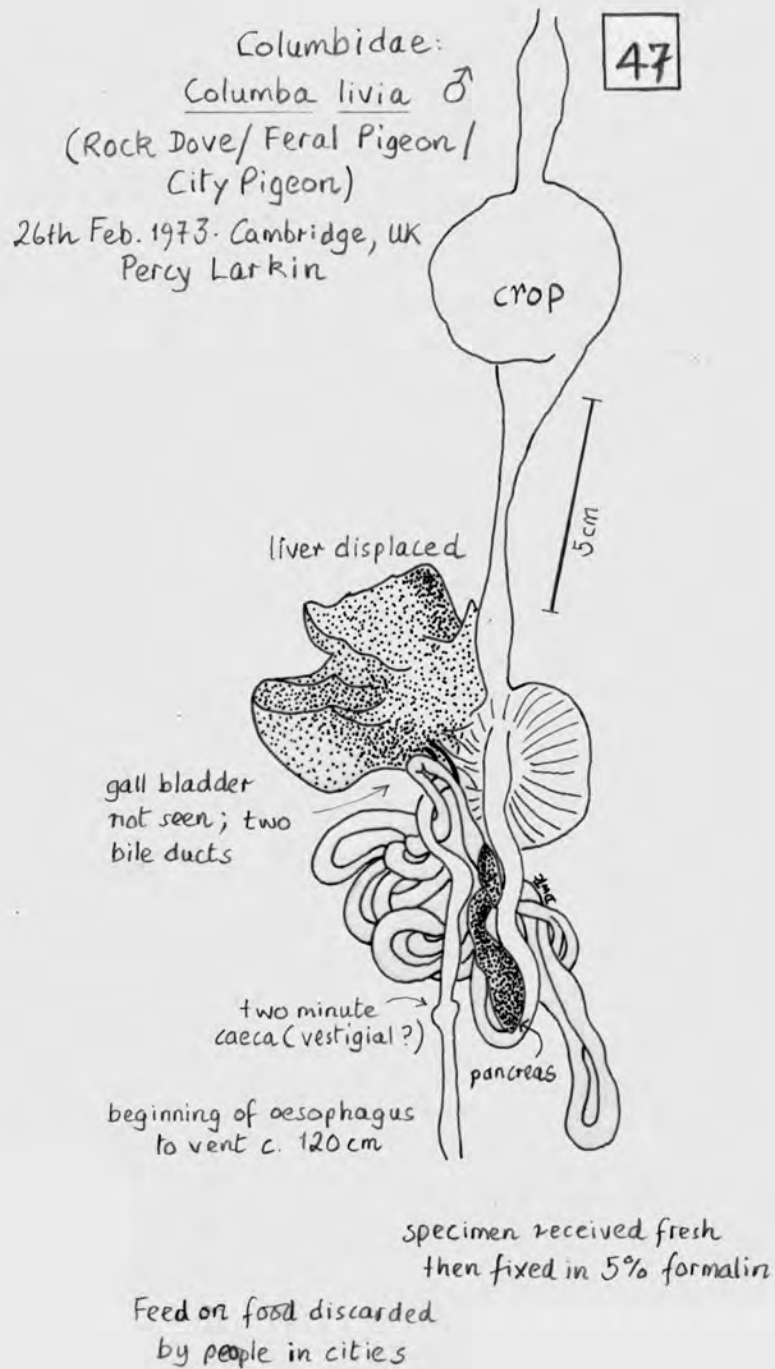
29th July 1974 · Chandigarh · India

NK Gupta



\*\* crop contained seeds and grains

\* Identified by Cori Benson,  
Dept of Zoology, University of Cambridge



47 *Columba livia* (Rock Dove: Feral Pigeon/City Pigeon)

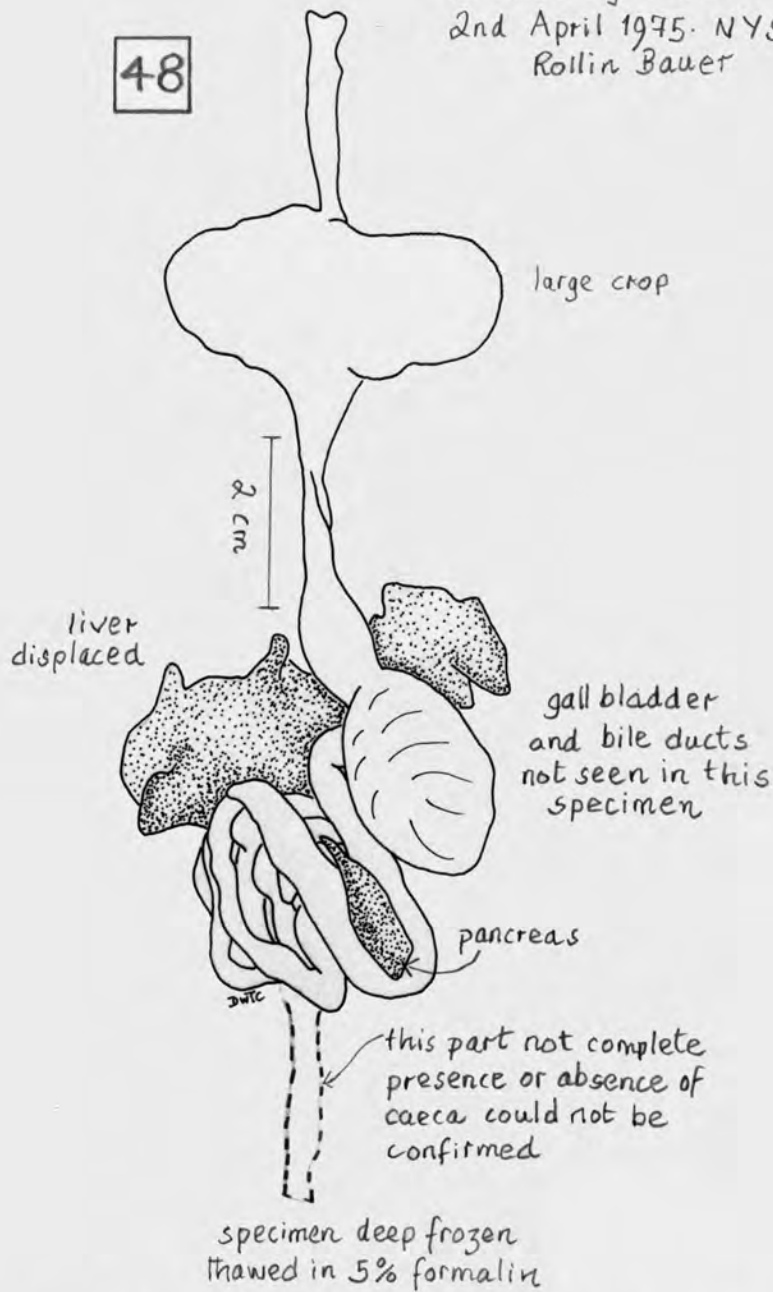


Columbidae:  
Zenaida macroura

(Mourning Dove)

2nd April 1975. NY State, USA  
Rollin Bauer

48



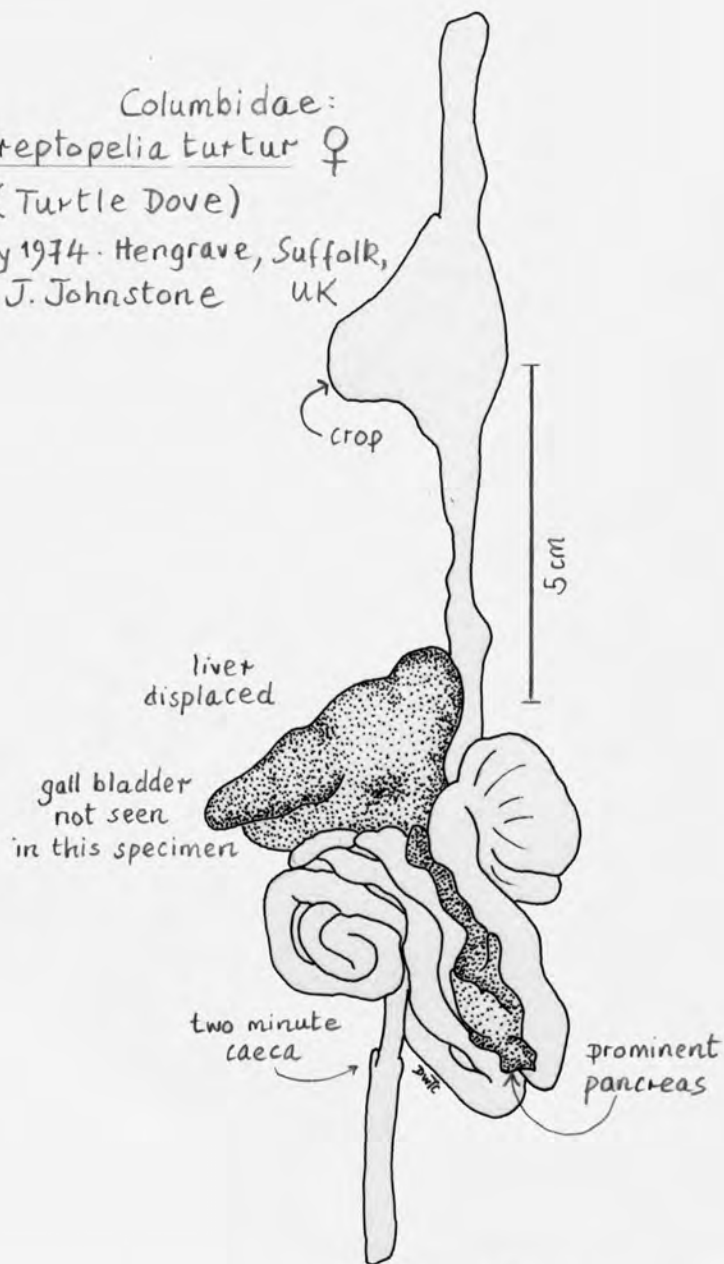
Vegetarian: diet of seeds, berries and plant material

48 *Zenaida macroura* (Mourning Dove)

49

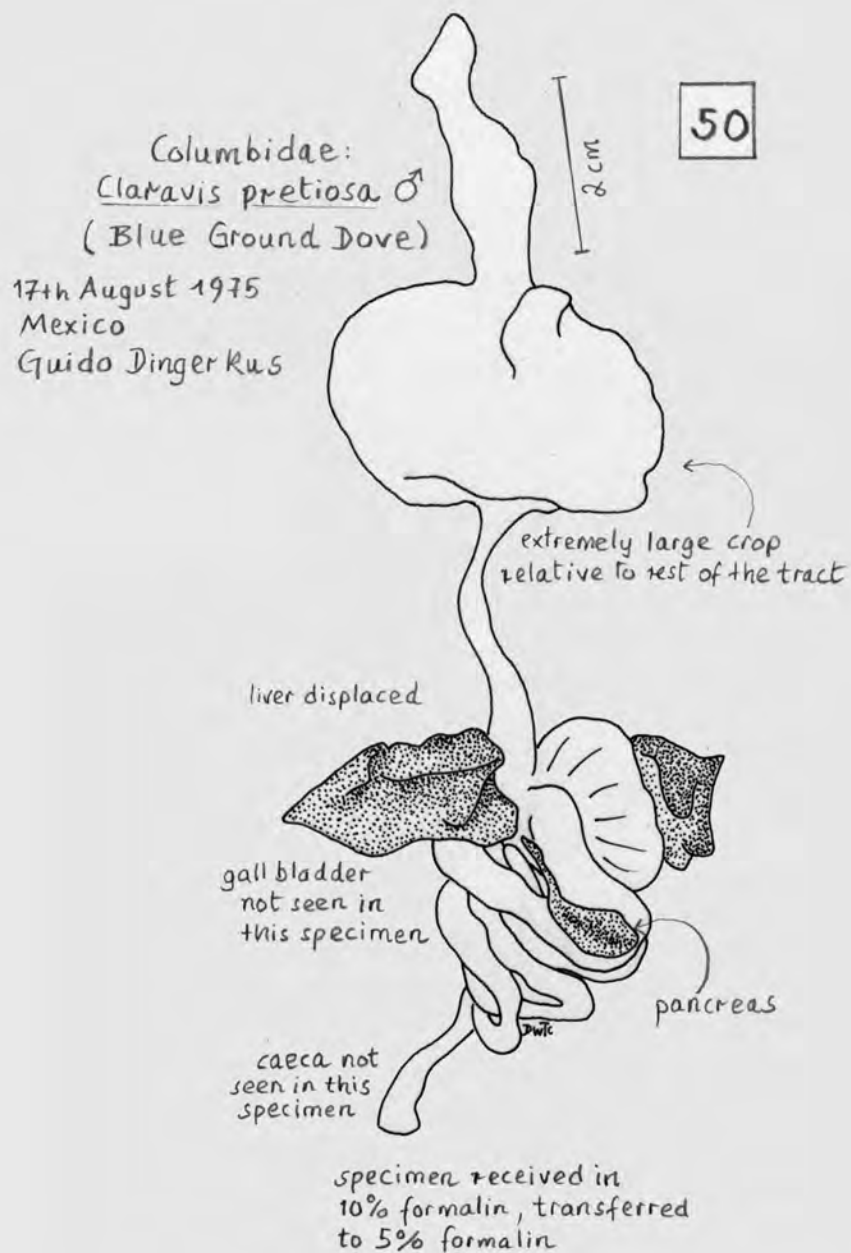
Columbidae:  
*Streptopelia turtur* ♀  
(Turtle Dove)

27th July 1974 · Hengrave, Suffolk,  
J. Johnstone UK



Specimen deep frozen  
thawed in 5% formalin

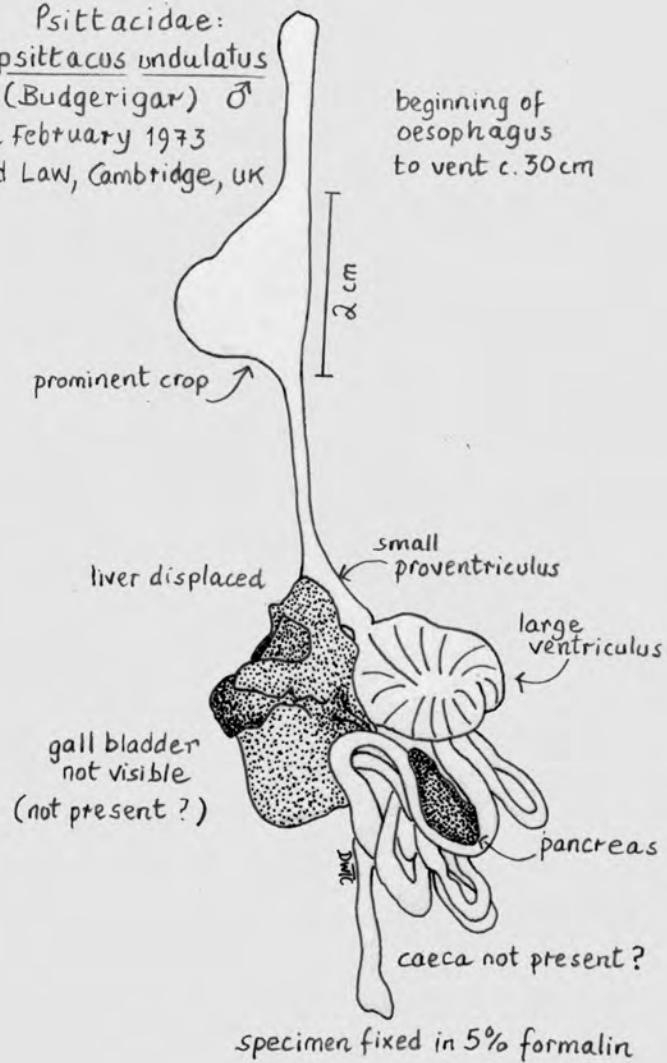
Vegetarian: diet mainly of seeds, berries  
young leaves



mainly vegetarian: diet of seeds, berries, young leaves  
 but will also take small invertebrates

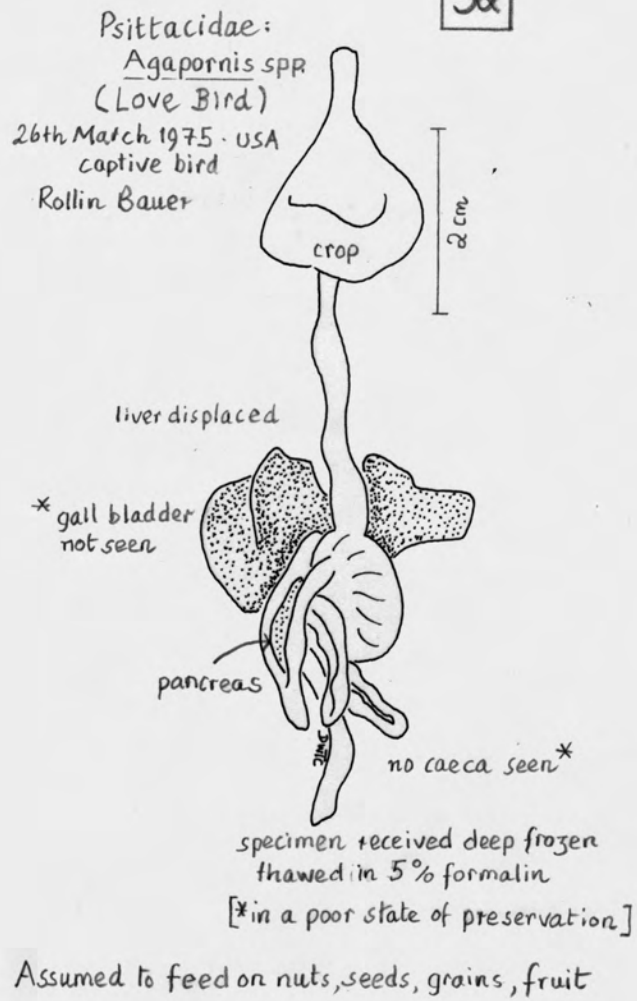
Psittacidae:  
Melopsittacus undulatus  
(Budgerigar) ♂  
26th February 1973  
David Law, Cambridge, UK

51

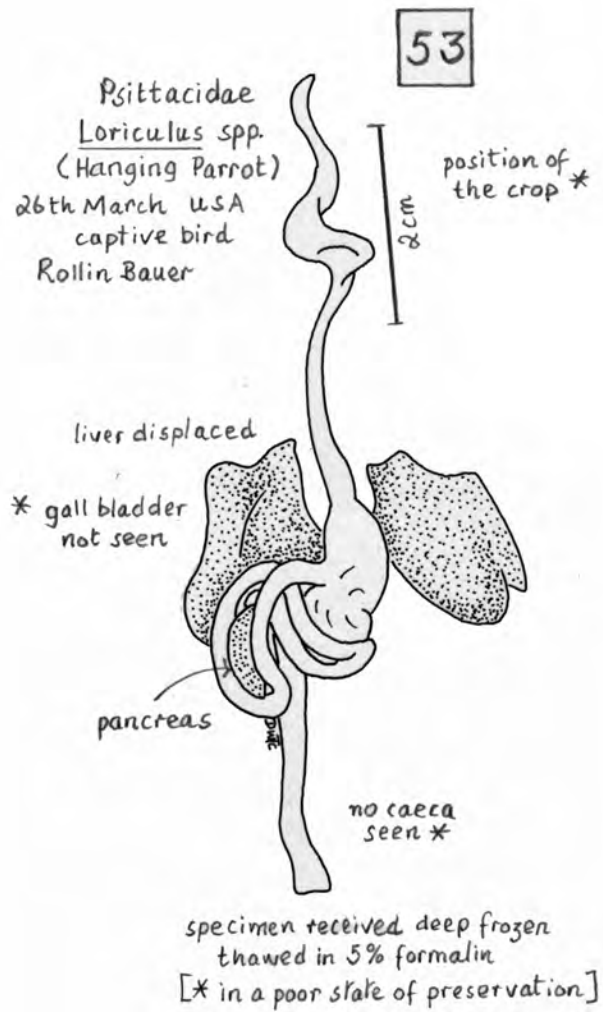


Feed on seeds, grains, insects

52



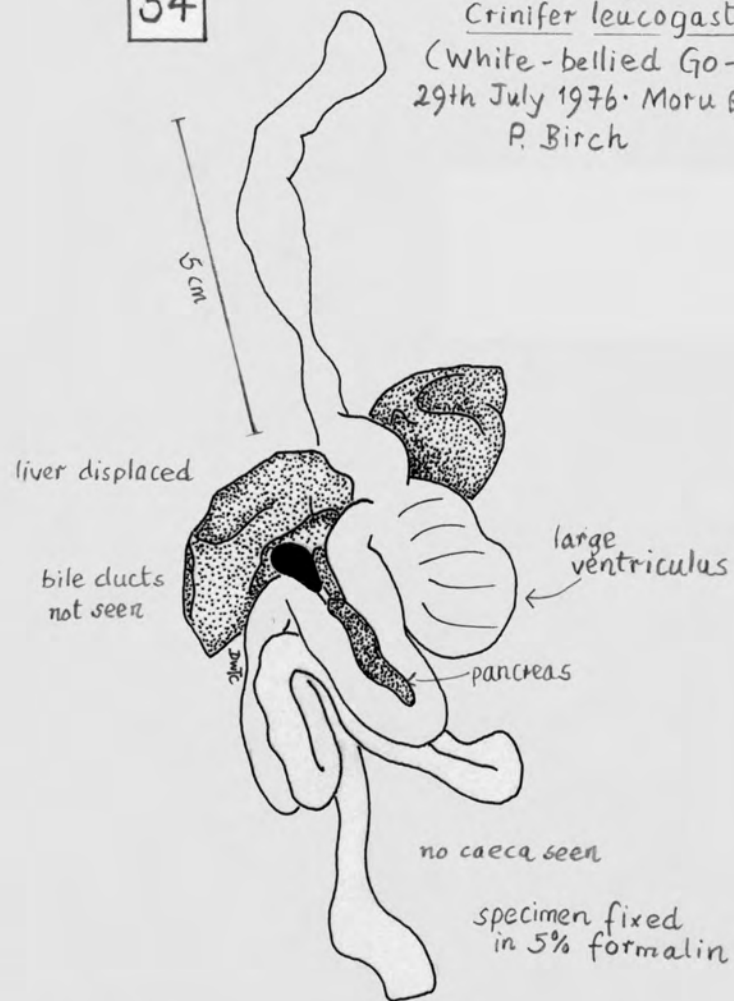




54

Musophagidae:  
*Crinifer leucogaster* ♂

(White-bellied Go-away Bird  
29th July 1976. Moru Ethez, Kenya  
P. Birch



Vegetarian: diet of fruits, foliage, flowers, buds

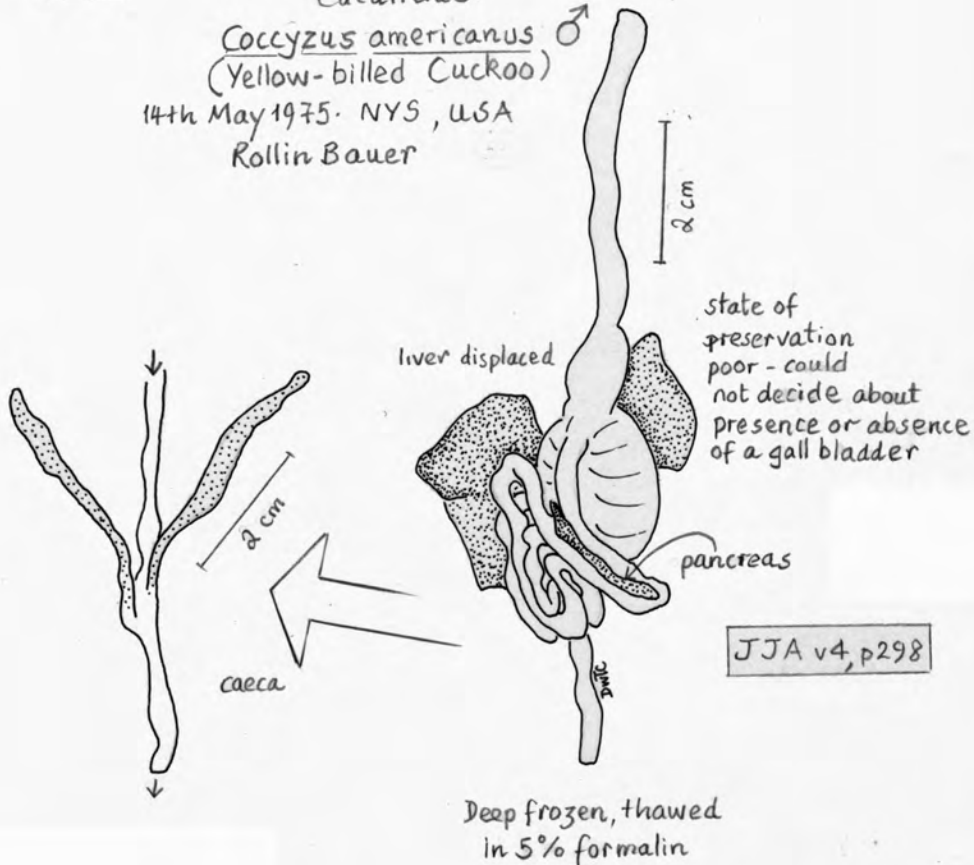
54 *Crinifer leucogaster* (White-bellied Go-away Bird)

55

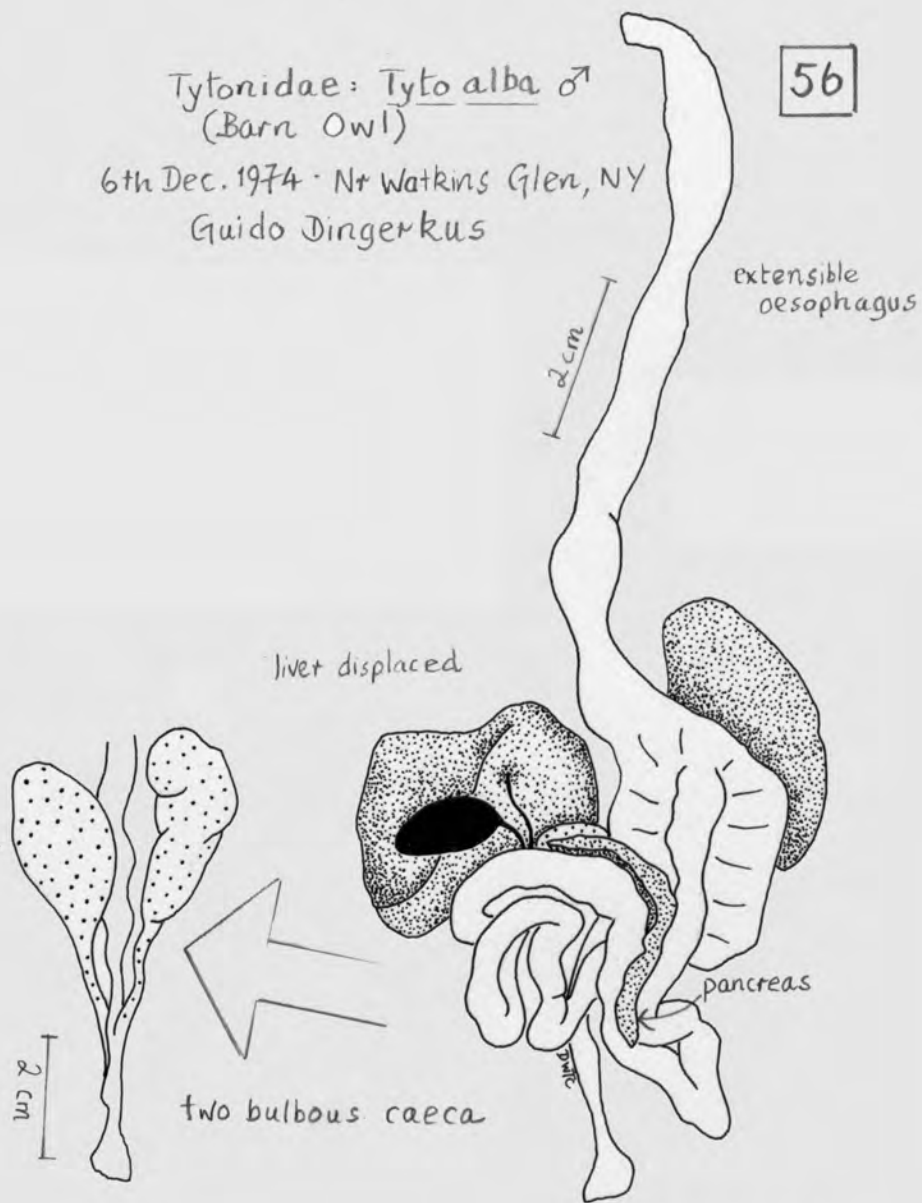
Cuculidae:

*Coccyzus americanus* ♂  
(Yellow-billed Cuckoo)

14th May 1975. NYS, USA  
Rollin Bauer



Elaine Kibby (Laboratory of Ornithology, Cornell University) said that this species eats many 'hairy caterpillars'. The hair is cleared from the tract by sloughing of the lining of the ventriculus.



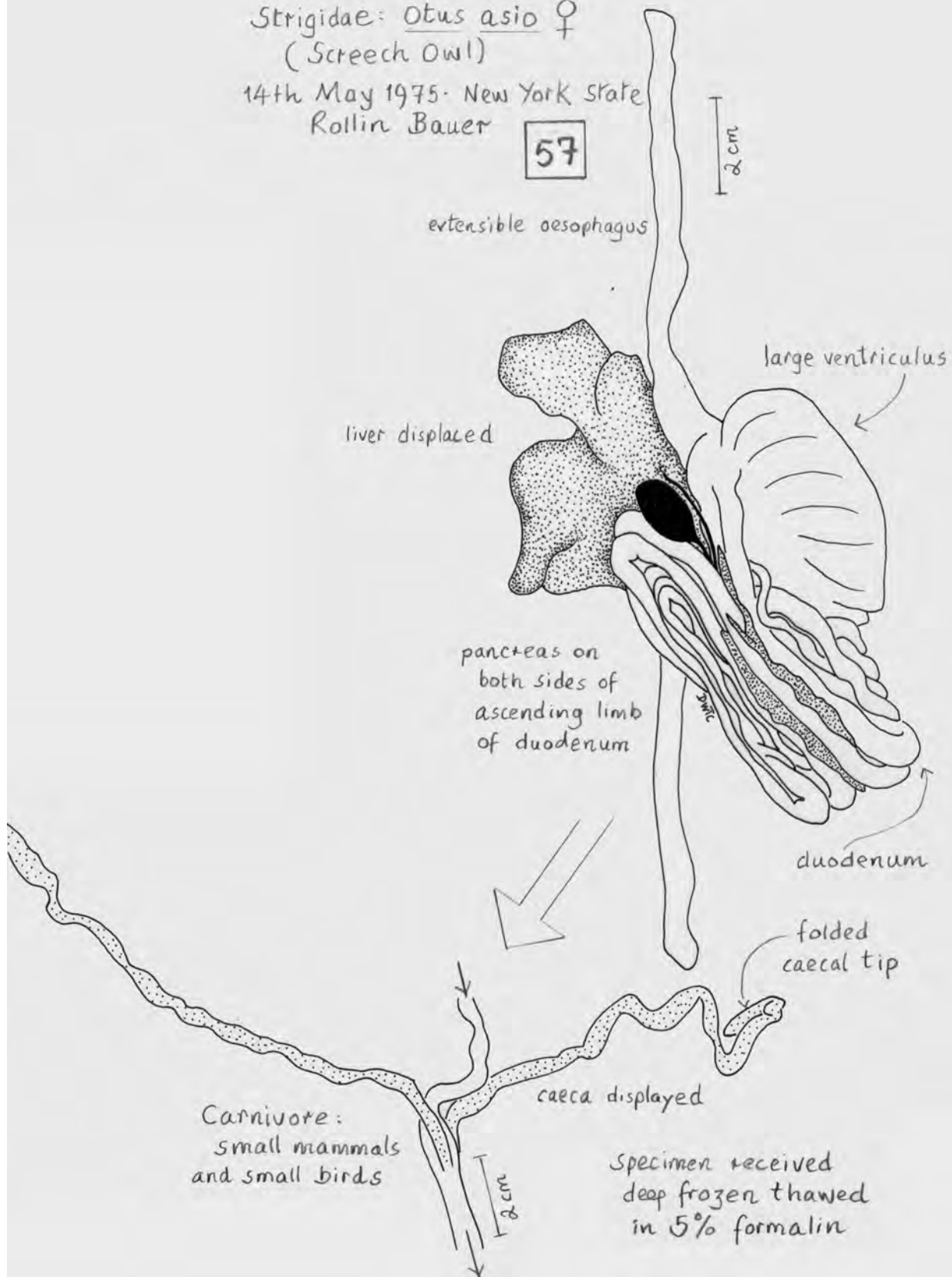
Specimen received  
in 10% formalin

Carnivore: diet of rodents, birds, insects, worms

Strigidae: Otus asio ♀  
(Screech Owl)

14th May 1975 · New York State  
Rollin Bauer

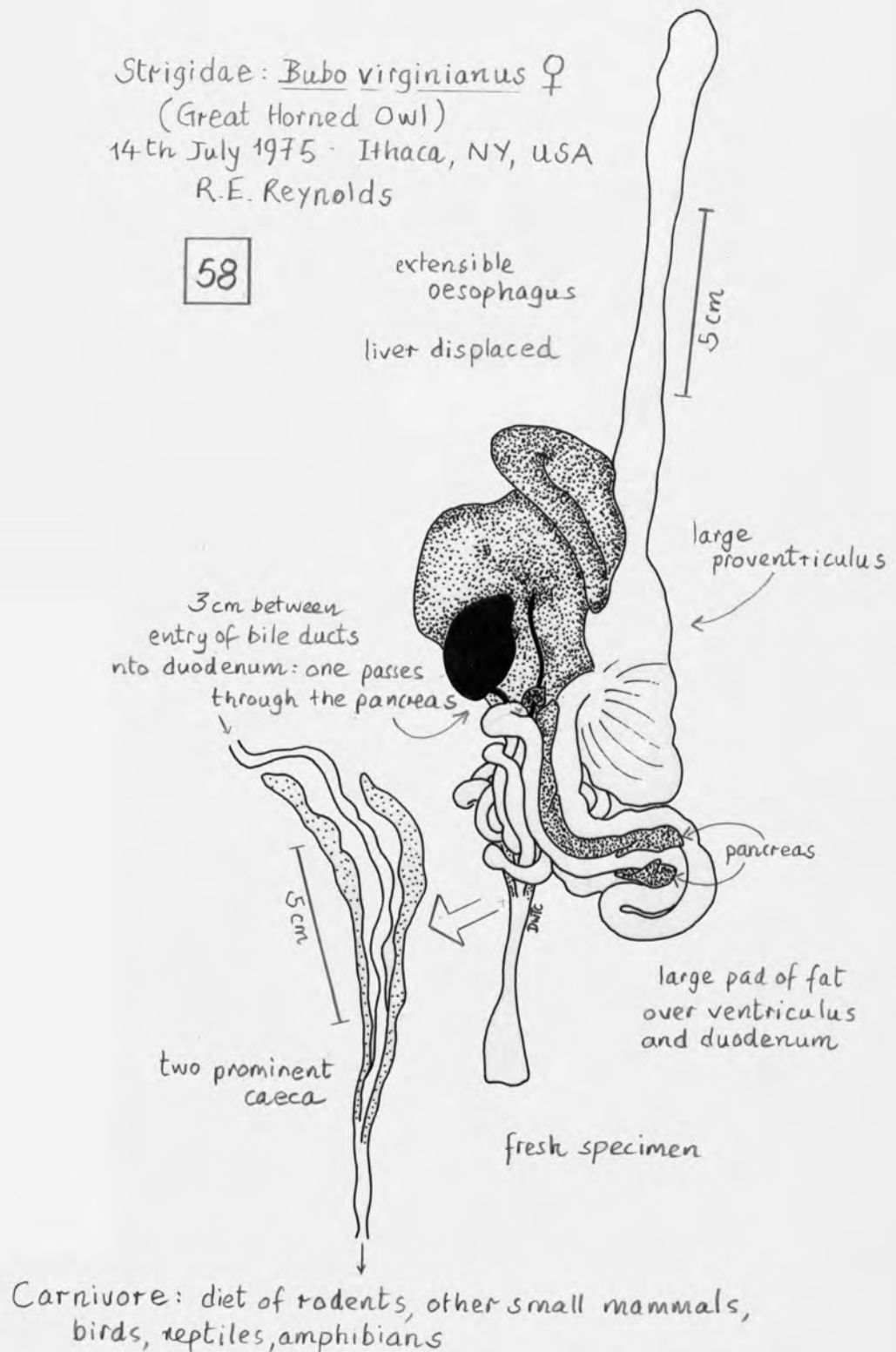
57



57 *Otus asio* (Screech Owl)

Strigidae: Bubo virginianus ♀  
 (Great Horned Owl)  
 14th July 1975 · Ithaca, NY, USA  
 R.E. Reynolds

58



58 *Bubo virginianus* (Great Horned Owl)



Strigidae: *Athene noctua* ♂  
 (Little Owl)  
 1st Sept. 1974 · Hengrave, Suffolk,  
 J. Johnstone UK

59

5 cm

liver displaced

two long caeca

large ventriculus

pancreas

Carnivore: diet of  
 insects, earthworms,  
 small birds, small mammals

Specimen received  
 deep frozen thawed  
 in 5% formalin

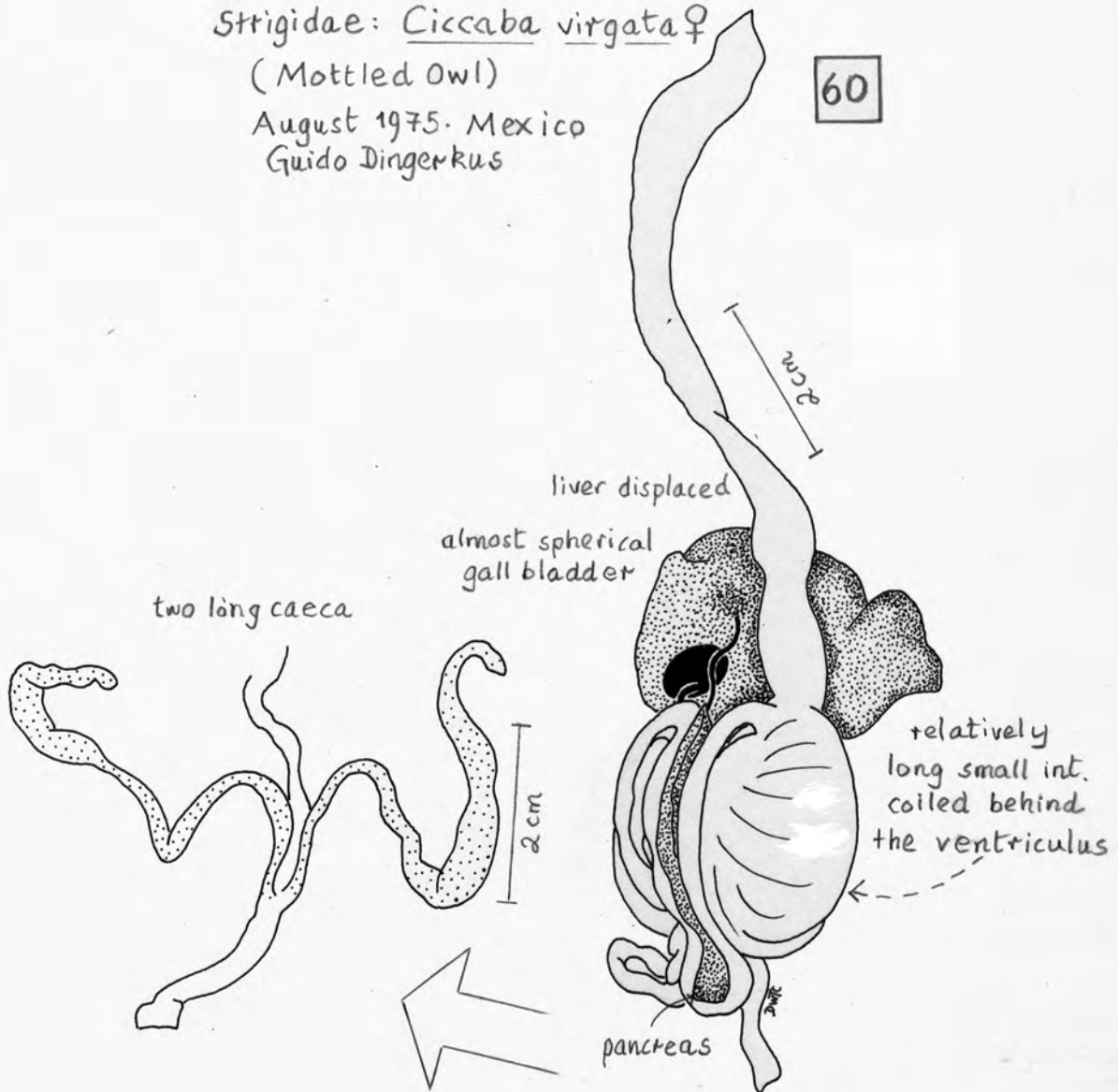
Strigidae: Ciccaba virgata ♀

(Mottled Owl)

August 1975. Mexico

Guido Dingerkus

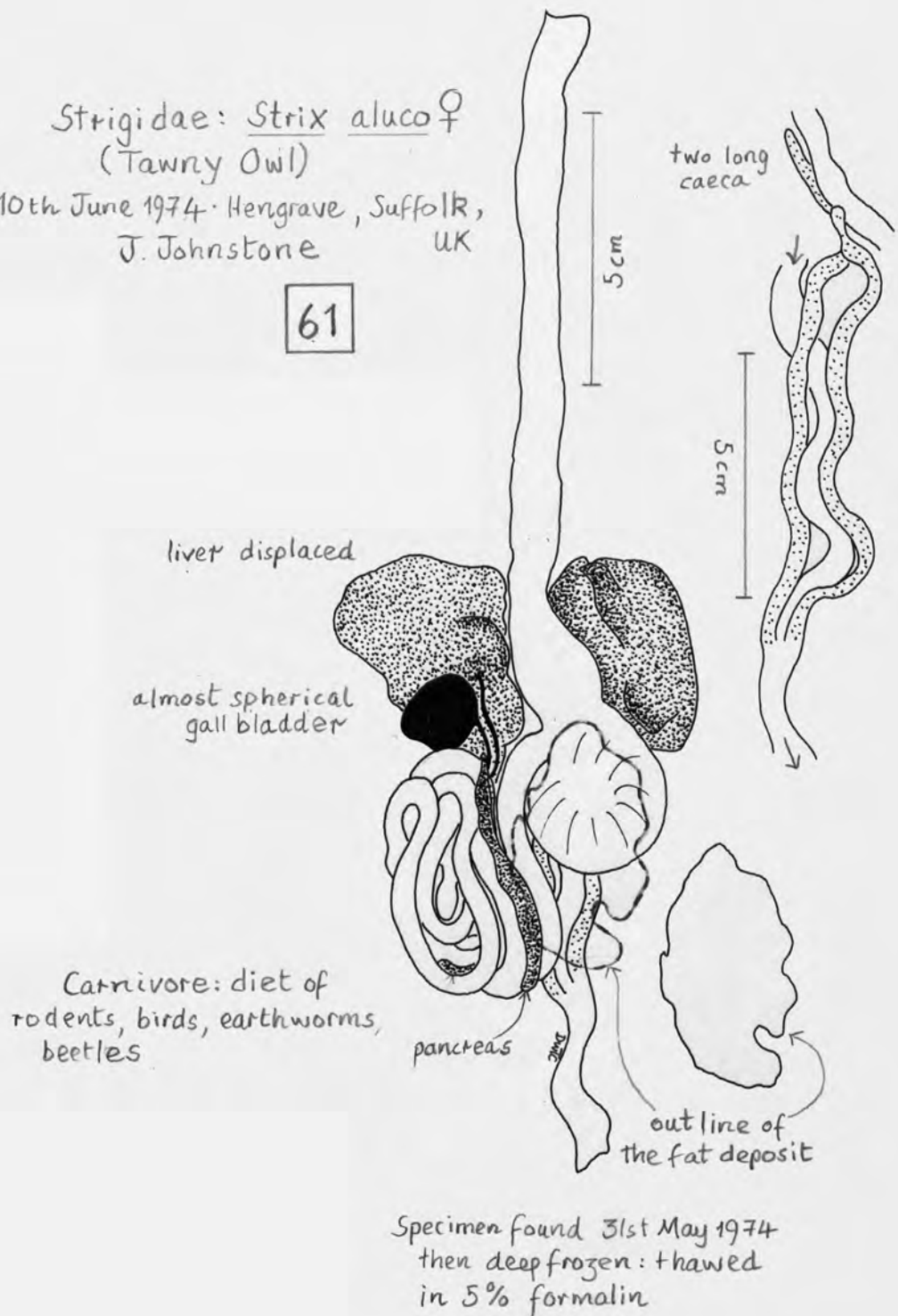
60



60 *Ciccaba virgata* (Mottled Owl)

Strigidae: Strix aluco ♀  
 (Tawny Owl)  
 10th June 1974 · Hengrave, Suffolk, UK  
 J. Johnstone

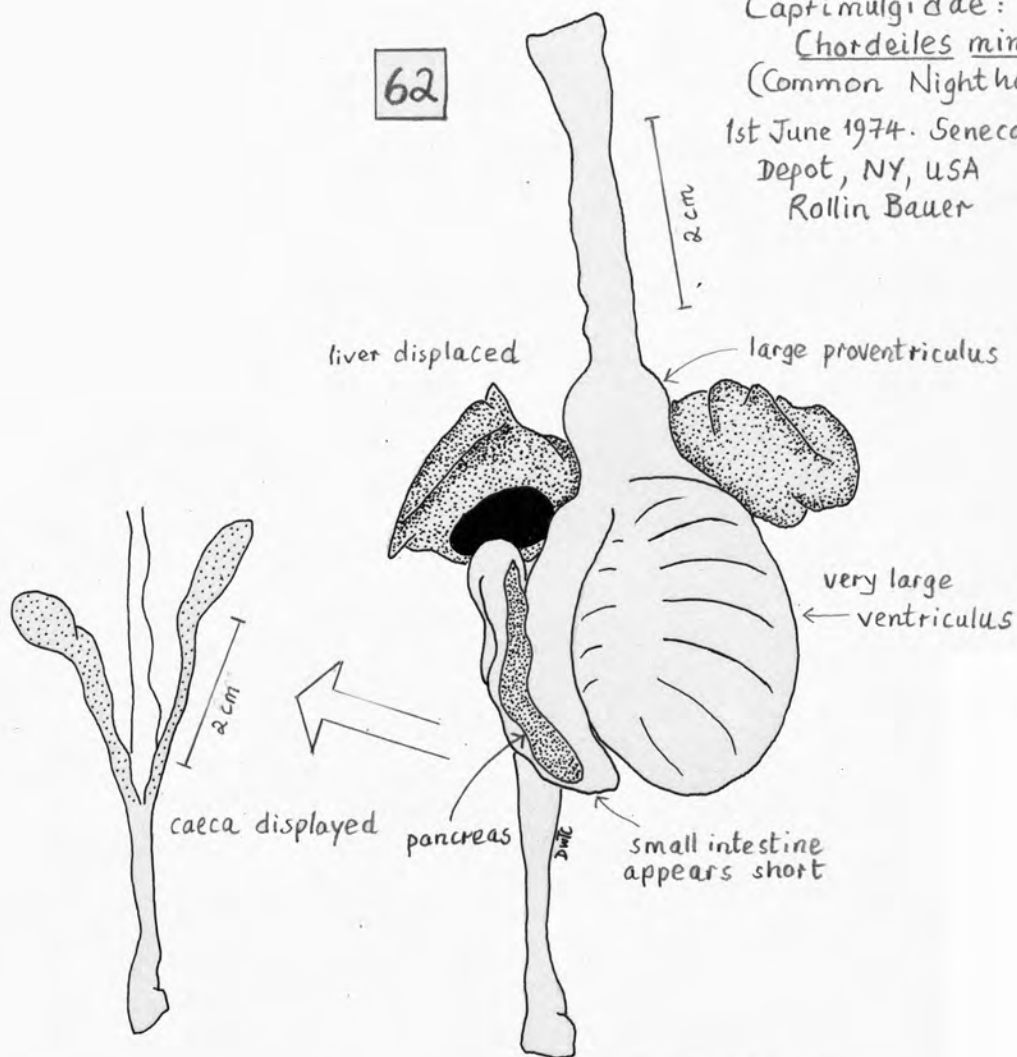
61



62

Captimulgidae:  
Chordeiles minor ♀  
(Common Nighthawk)

1st June 1974. Seneca Army  
Depot, NY, USA  
Rollin Bauer



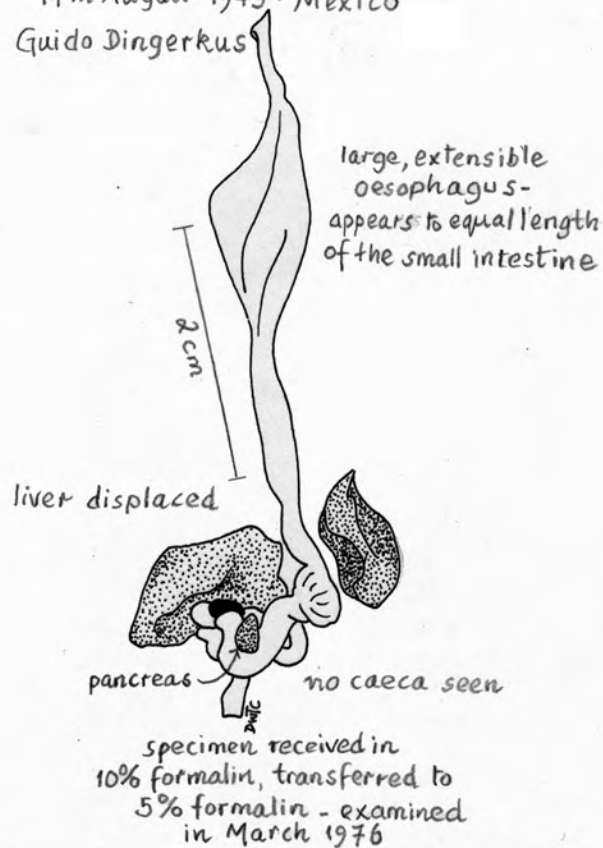
specimen deep frozen  
thawed in 5% formalin  
received 14th May 1975

Nocturnal feeders: diet of moths  
and large insects

62 *Chordeiles minor* (Common Nighthawk)

63

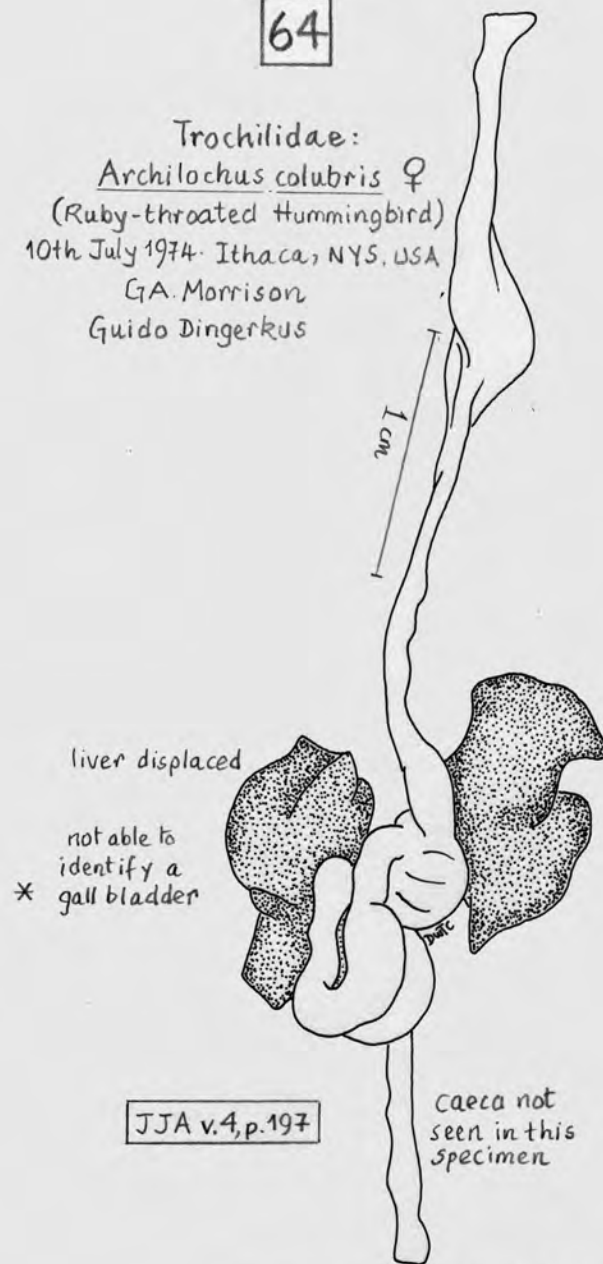
Trochilidae:  
Eugenes fulgens ♂  
 (Magnificent [Rivoli's] Hummingbird)  
 17th August 1975 · Mexico  
 Guido Dingerkus



Diet of nectar (red flowers in particular), aphids,  
 small insects, spiders

64

Trochilidae:  
*Archilochus colubris* ♀  
(Ruby-throated Hummingbird)  
10th July 1974. Ithaca, NYS, USA  
G.A. Morrison  
Guido Dingerkus



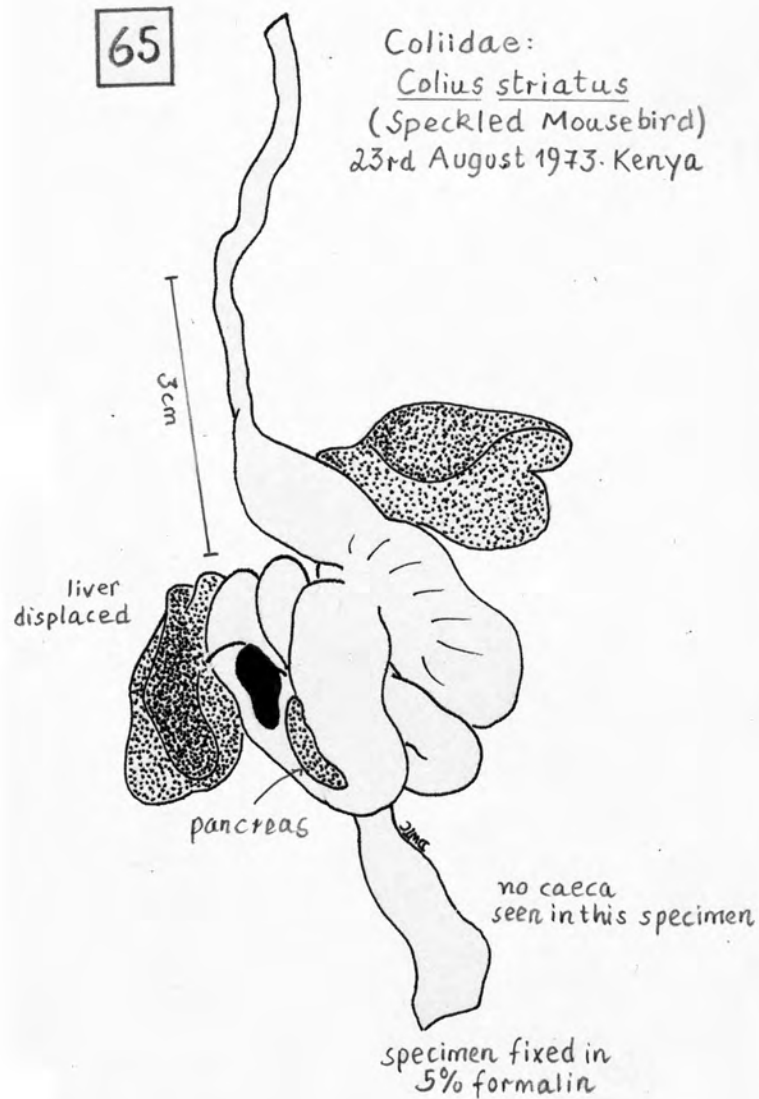
specimen received in 10% formalin  
transferred to 5% formalin  
[\*in a poor state of preservation]  
26th June 1975

Diet of nectar, small insects, spiders



65

Coliidae:  
Colius striatus  
(Speckled Mousebird)  
23rd August 1973. Kenya



Vegetarian: leaves, fruit, seeds, nectar

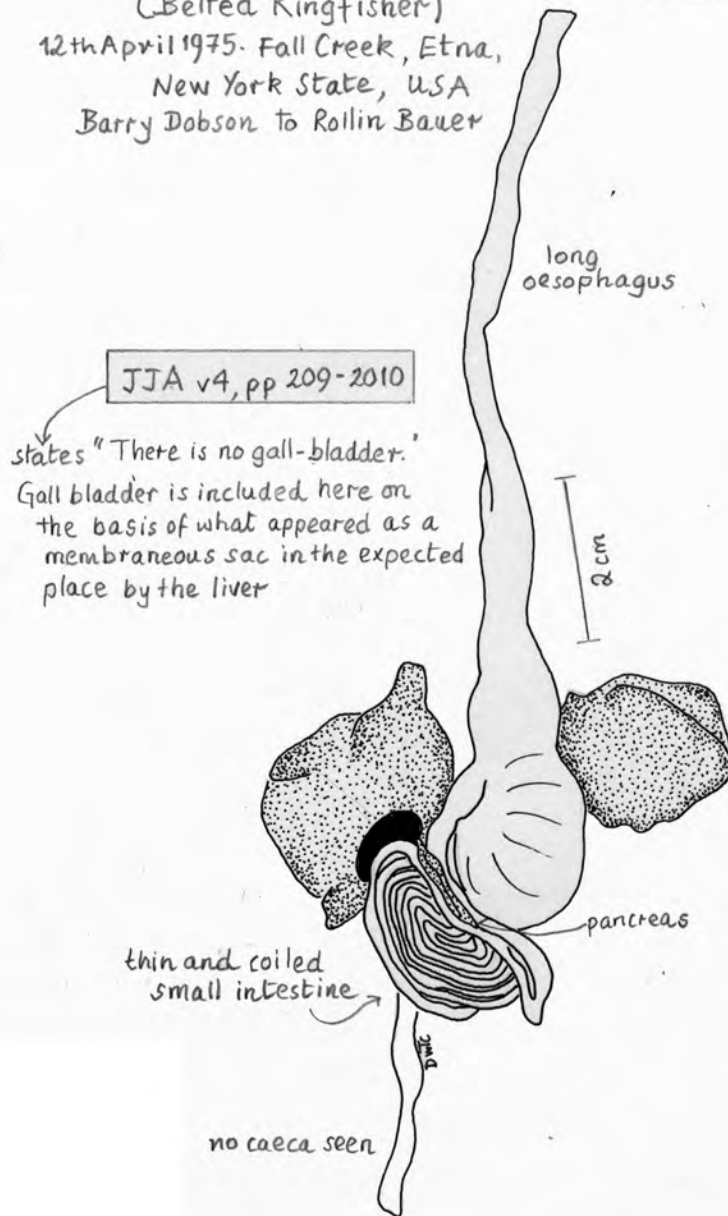
Alcedinidae:

Ceryle alcyon

(Belted Kingfisher)

12th April 1975. Fall Creek, Etna,  
New York State, USA  
Barry Dobson to Rollin Bauer

66



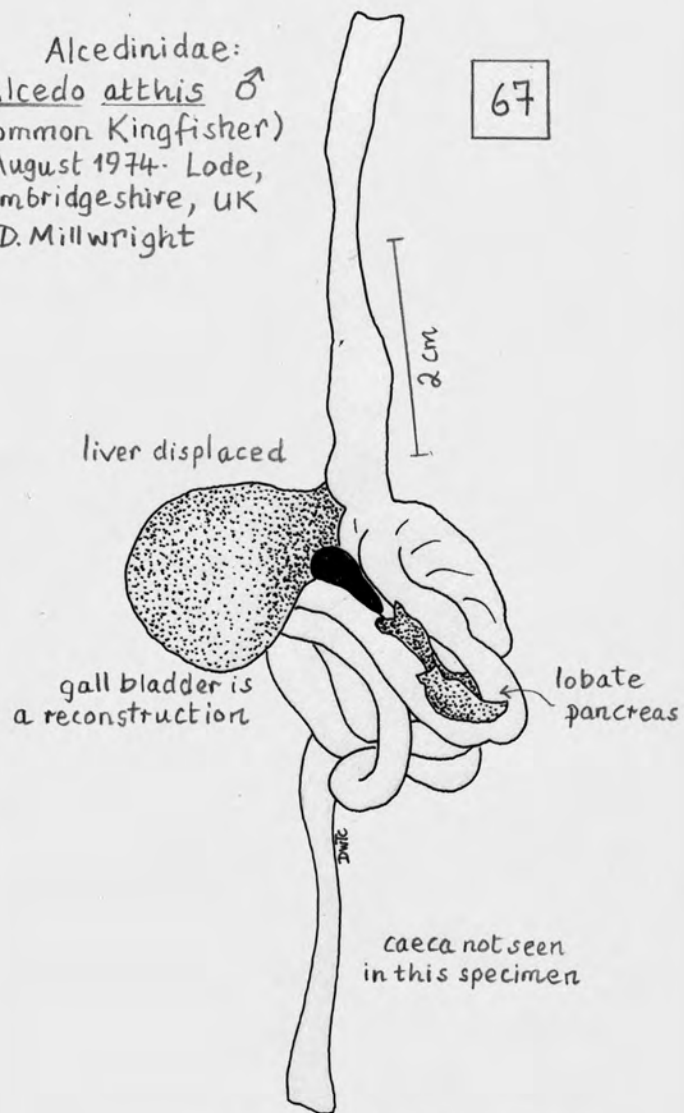
specimen received 14th May 1975  
deep frozen, thawed in 5% formalin

Diet of mainly fish

66 *Ceryle alcyon* (Belted Kingfisher)

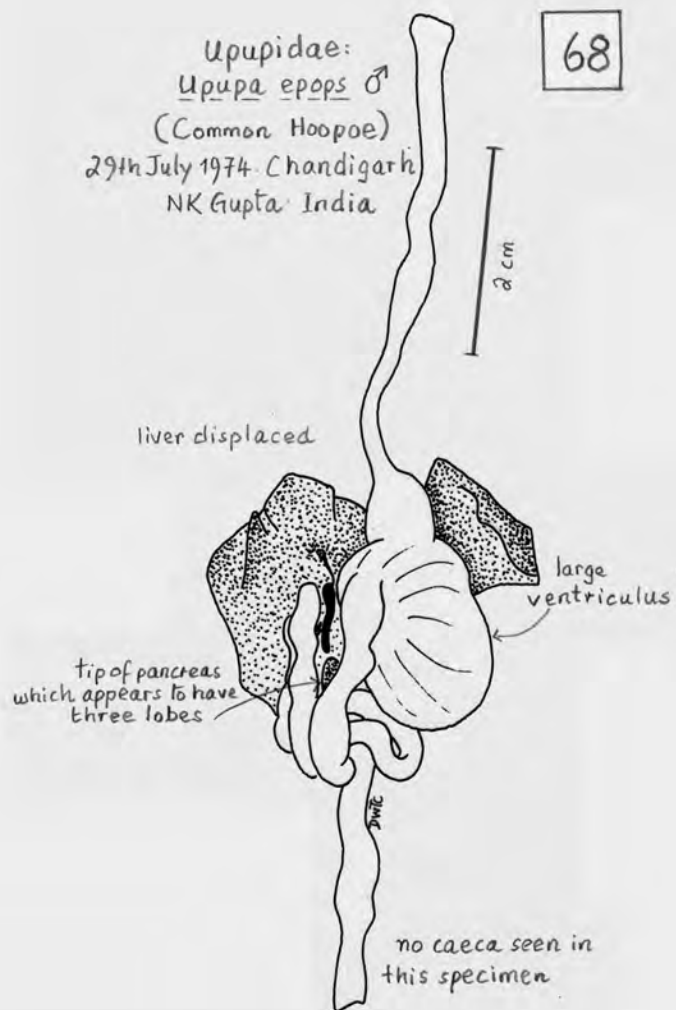
Alcedinidae:  
*Alcedo atthis* ♂  
 (Common Kingfisher)  
 13th August 1974. Lode,  
 Cambridgeshire, UK  
 D. Millwright

67



specimen received deep frozen  
 thawed in 5% formalin

Feed on a variety of small freshwater fish, aquatic  
 insects and crustaceans



specimen fixed in 5% formalin  
 examined 1st November 1974

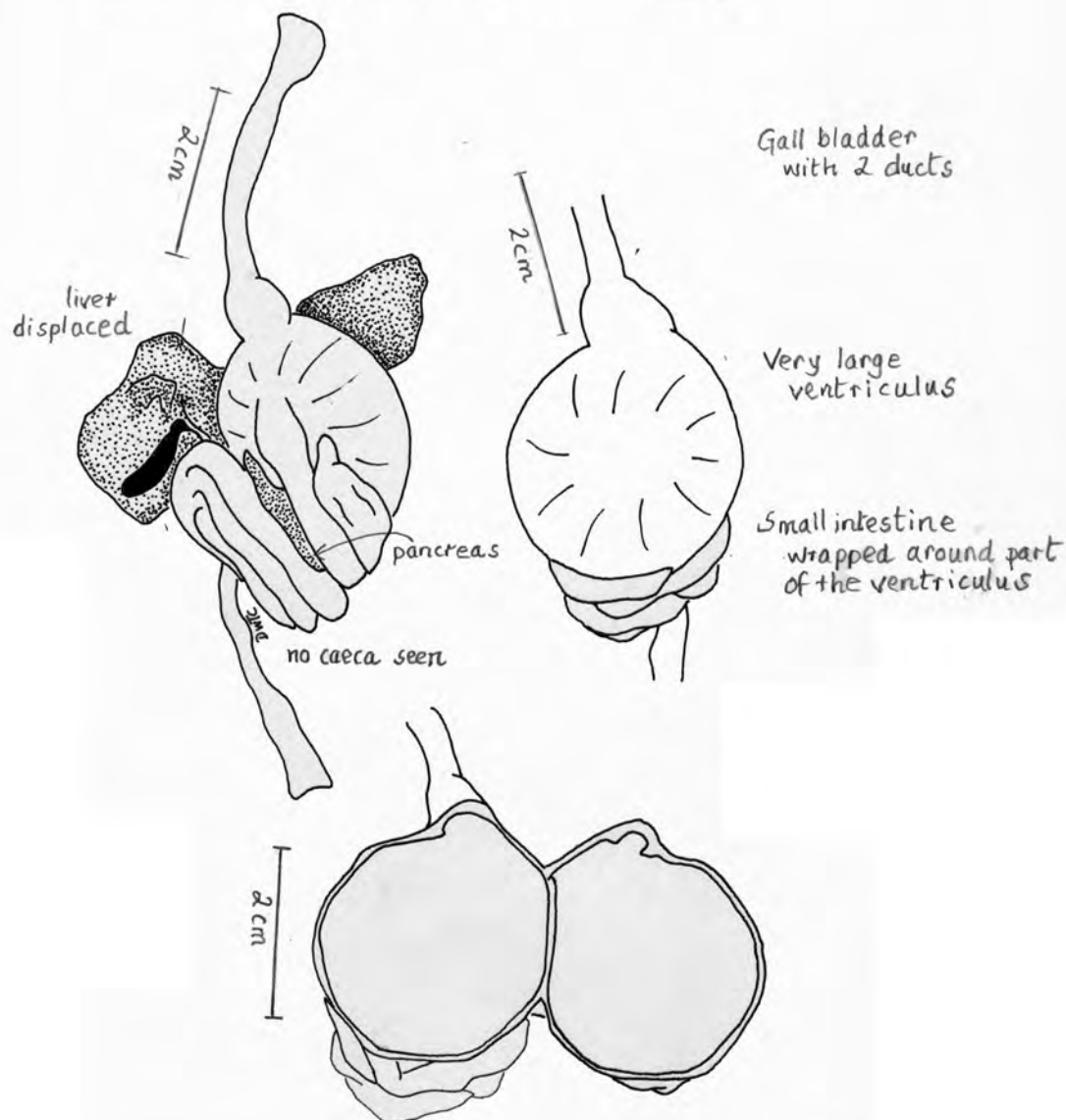
Ground feeders on a diet including insect nymphs  
 and larvae, ants, termites, spiders, woodlice

Indicatoridae: Indicator minor (Lesser Honeyguide)

Katito, Kenya 1977

received fixed in formaldehyde

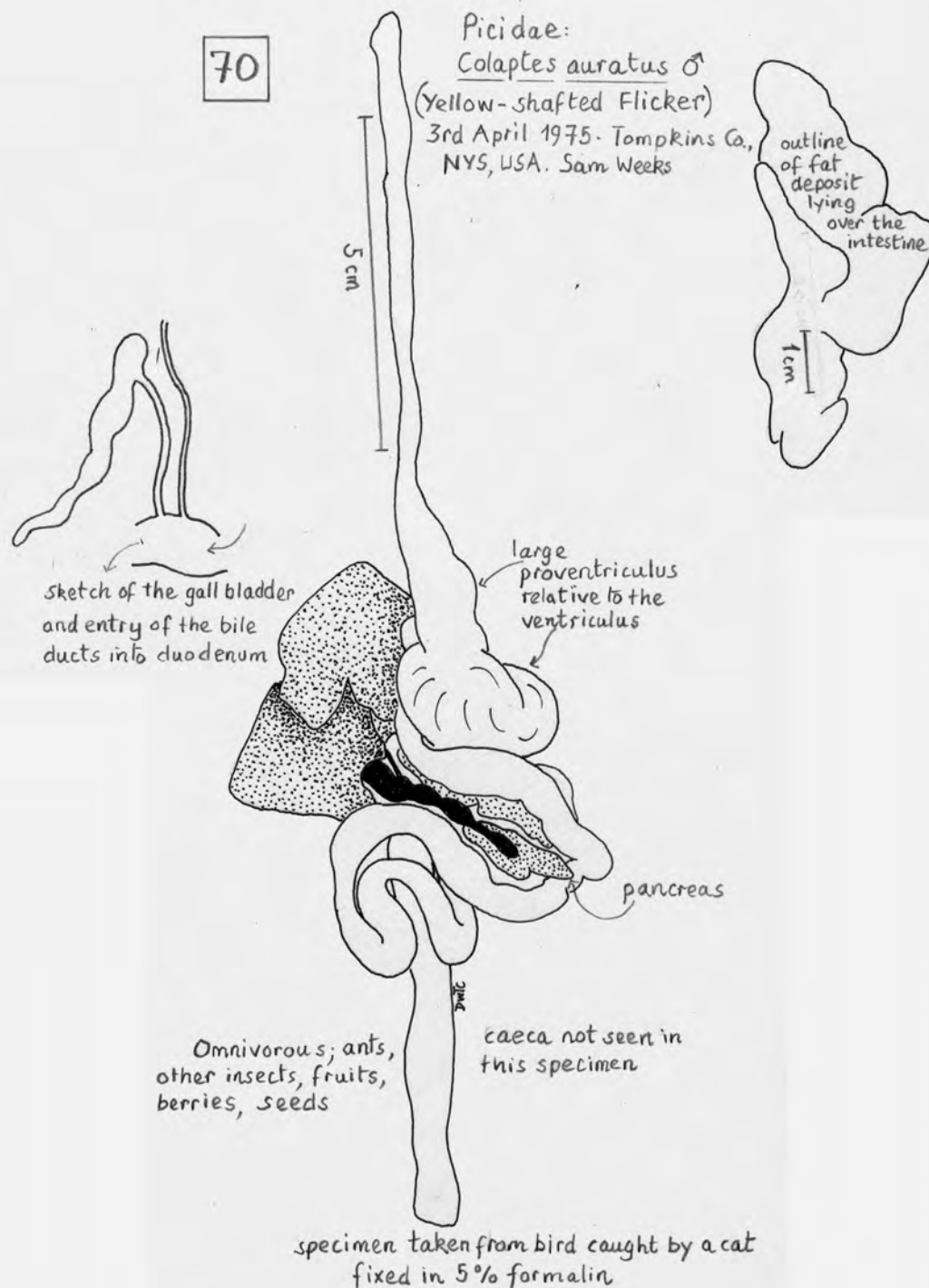
69



On opening the ventriculus it was found to be very thin walled - not muscular - and packed tight with brown 'fibrous' material

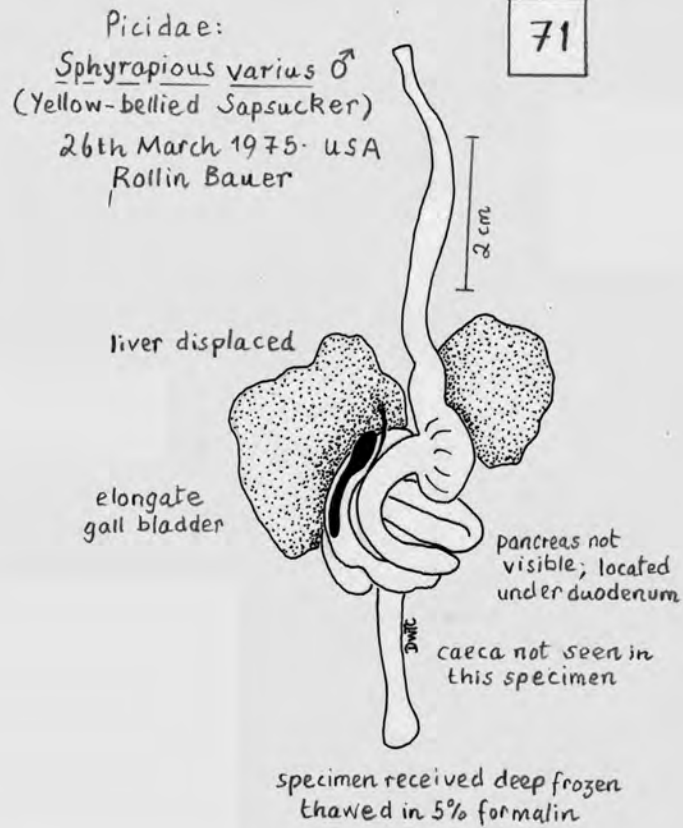
On 12<sup>th</sup> August 1978 George Mewis examined the contents of the ventriculus (x8.75 mag.). Cocoons were present held together by beeswax. Small lumps of beeswax were also present. A higher magnification (x250) revealed quantities of pollen and silk threads from the cocoons.

69 *Indicator minor* (Lesser Honeyguide)



70 *Colaptes auratus* (Yellow-shafted Flicker/Common Flicker)



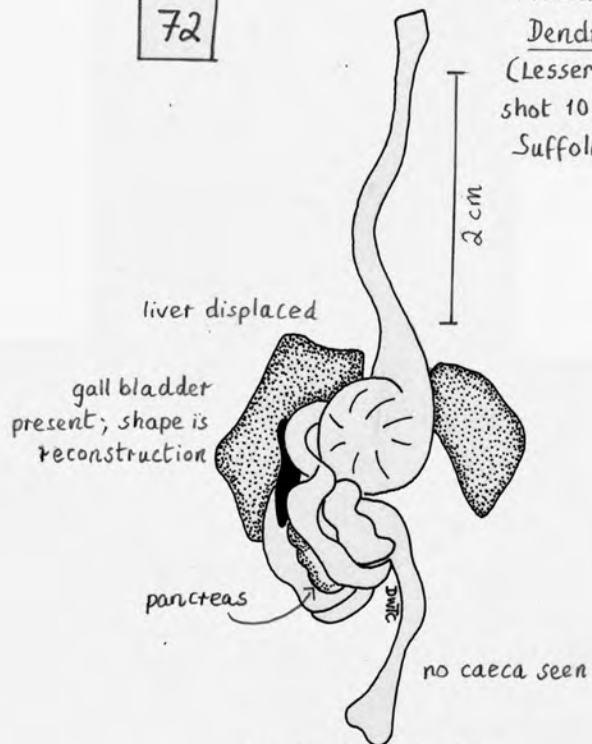


Omnivorous; insects, sap, fruit, berries

72

Picidae:

*Dendrocopos minor* ♂  
(Lesser Spotted Woodpecker)  
shot 10th March 1975, Hengrave,  
Suffolk, UK · J. Johnstone



specimen received in  
5% formalin 20th Oct. 1975

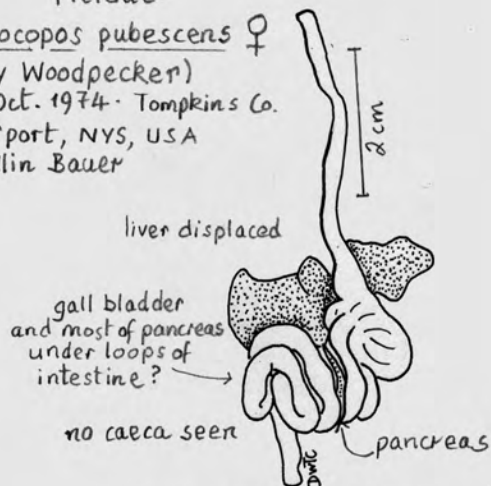
Feed mainly on insects in wood and  
on the surface of bark

72 *Dendrocopos minor* (Lesser Spotted Woodpecker)

73

Picidae:

*Dendrocopos pubescens* ♀  
(Downy Woodpecker)  
11th Oct. 1974 · Tompkins Co.  
Airport, NYS, USA  
Rollin Bauer

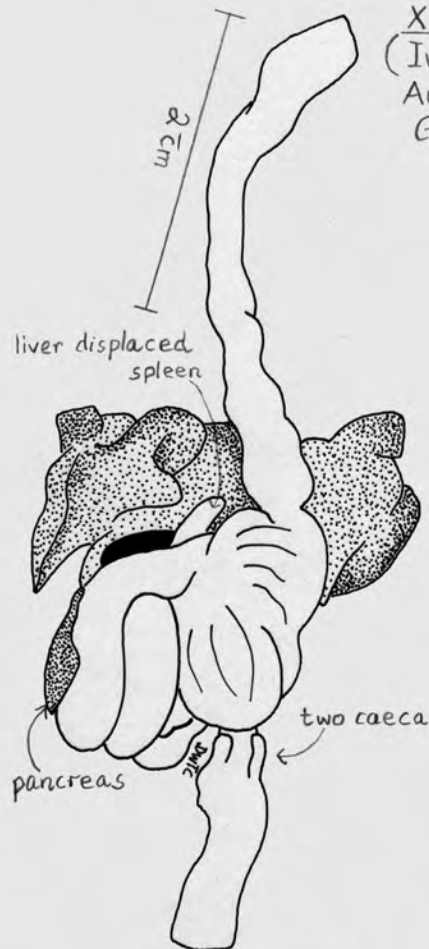


specimen received deep frozen  
thawed in 5% formalin  
19th March 1975

Feed mainly on insects, also seeds, berries

74

Dendrocolaptidae  
Xiphorhynchus flavigaster ♂  
(Ivory-billed Woodcreeper)  
August 1975 · Mexico  
Guido Dingerkus



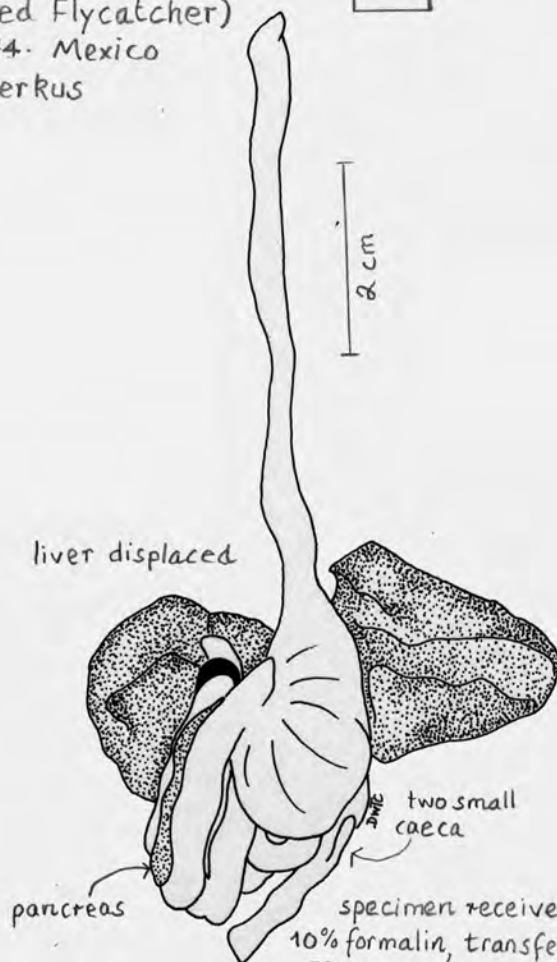
specimen received in  
10% formalin, transferred to  
5% formalin, and examined in March 1976

Carnivore: diet includes insects, spiders, small frogs

74 *Xiphorhynchus flavigaster* (Ivory-billed Woodcreeper)

Tyrannidae:  
Megarhynchus pitangua ♂  
 (Boat-billed Flycatcher)  
 16th August 1974. Mexico  
 Guido Dingerkus

75



specimen received in  
 10% formalin, transferred to  
 5% formalin and examined March 1975

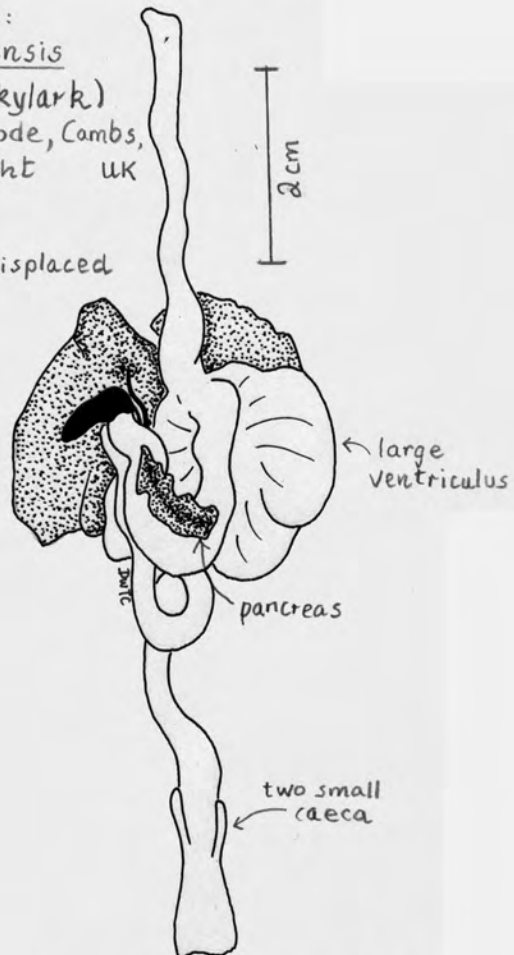
Carnivore: insects of all kinds, some crustaceans (isopods),  
 probably fruits on occasion

76

Alaudidae:  
*Alauda avensis*  
(Eurasian Skylark)  
13th August 1974. Lode, Combs,  
D. Millwright UK

liver displaced

2 cm



specimen received deep frozen  
thawed in 5% formalin

Ground feeder; seeds, insects

76 *Alauda avensis* (Eurasian Skylark)



Specimen from North America

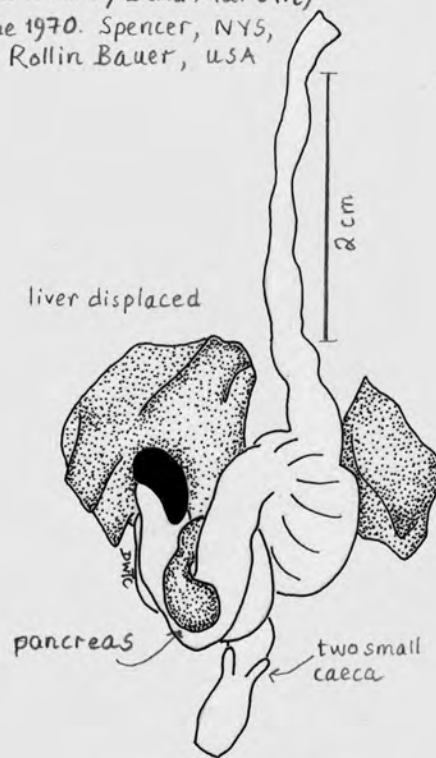
Hirundinidae:

Riparia riparia ♂

(Bank Swallow/Sand Martin)

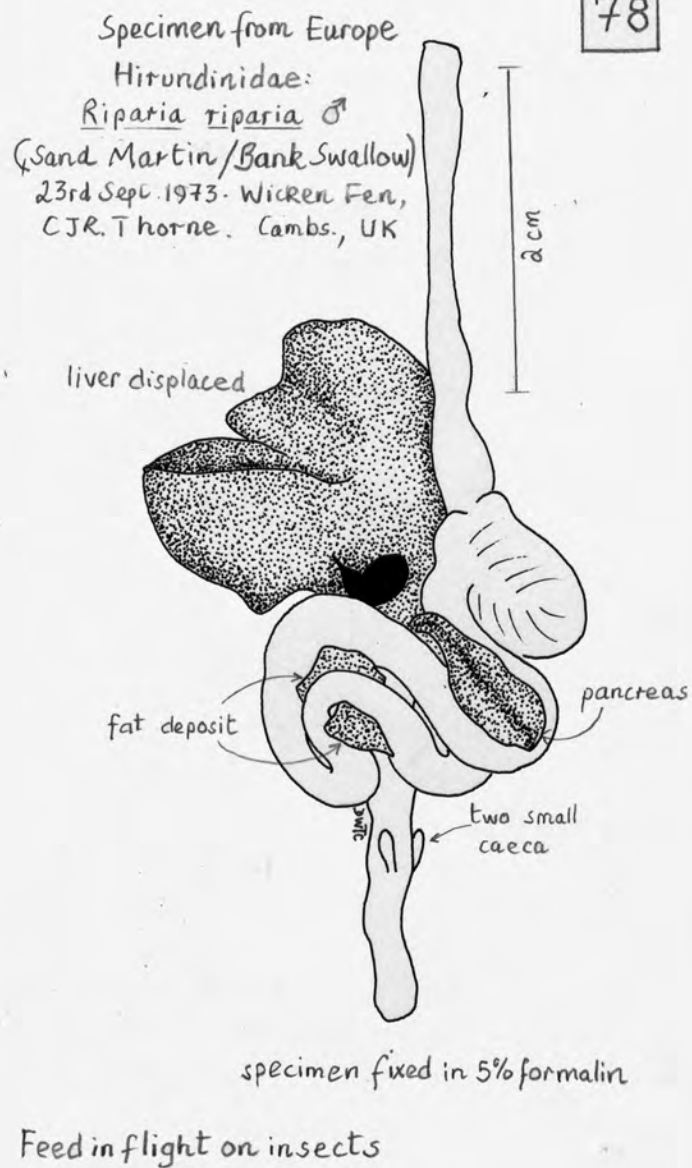
17th June 1970. Spencer, NYS,  
Rollin Bauer, USA

77

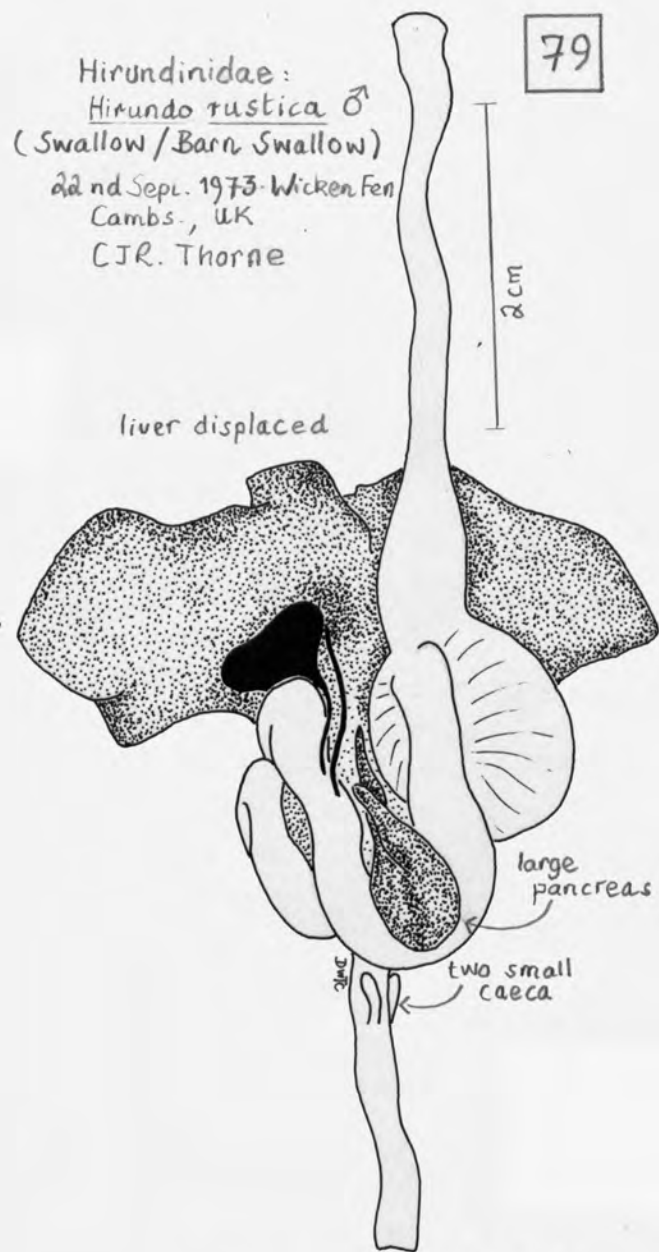


specimen deep frozen  
thawed in 5% formalin and  
examined 19th March 1975

Specialist feeder on day-flying insects

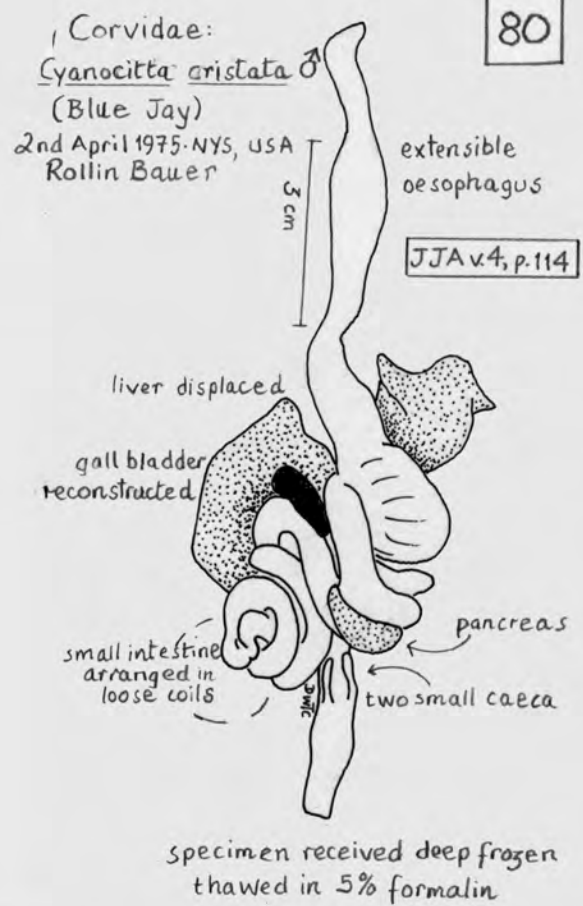


78 *Riparia riparia* (Sand Martin/Bank Swallow)-Europe

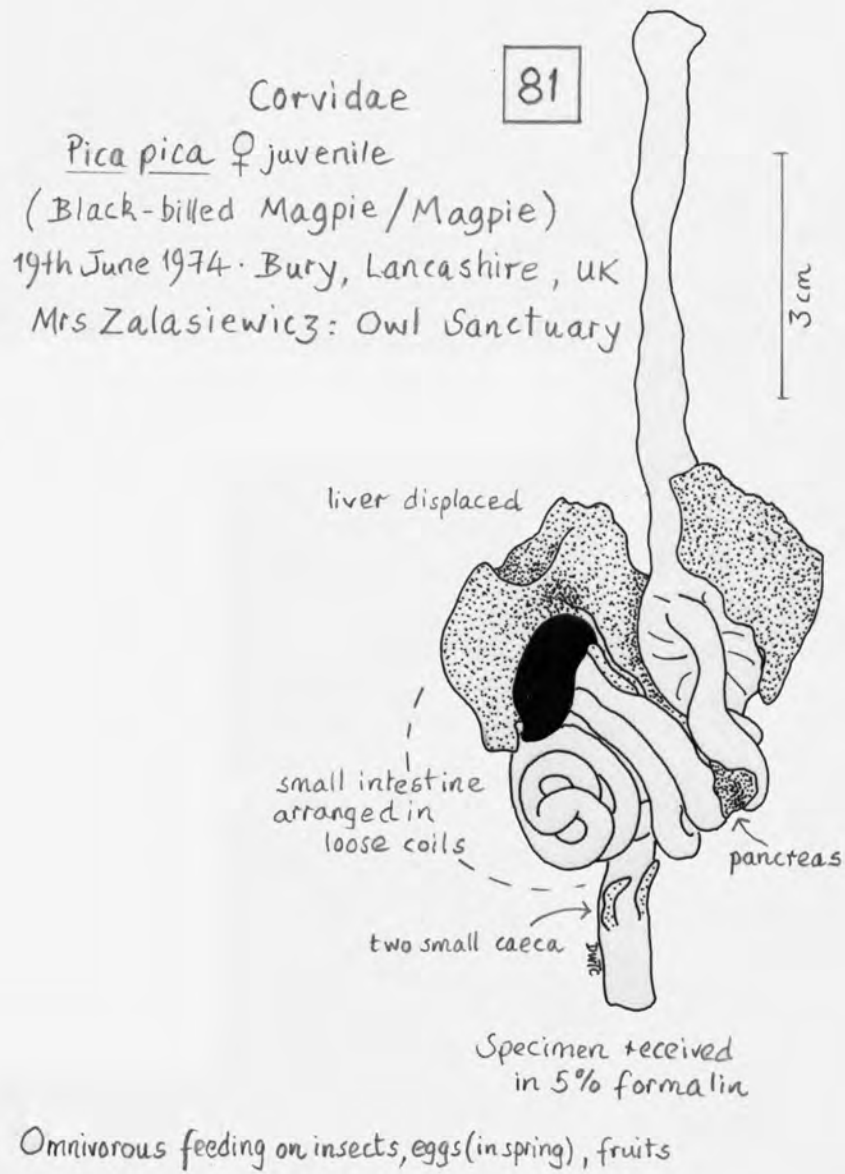


specimen fixed in 5% formalin

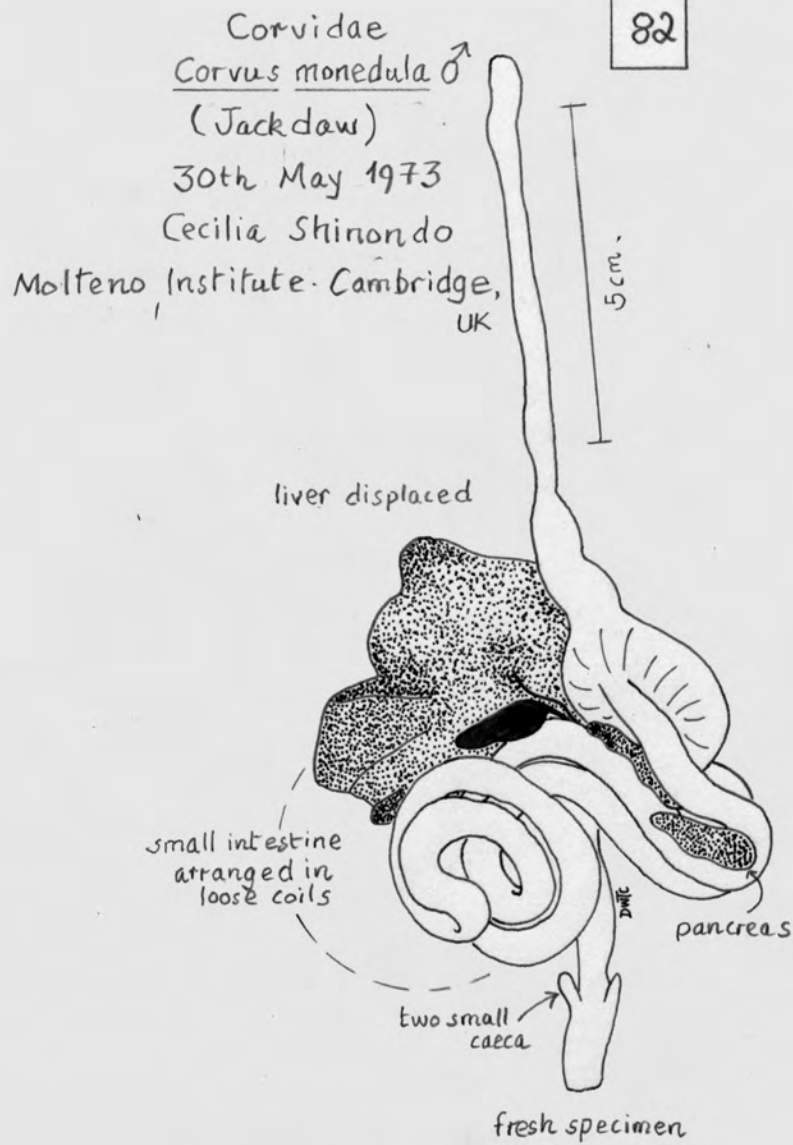
Feed almost exclusively on flying insects



Opportunistic omnivore; acorns, nuts, seeds,  
 berries, fruits, food scraps, invertebrates, eggs

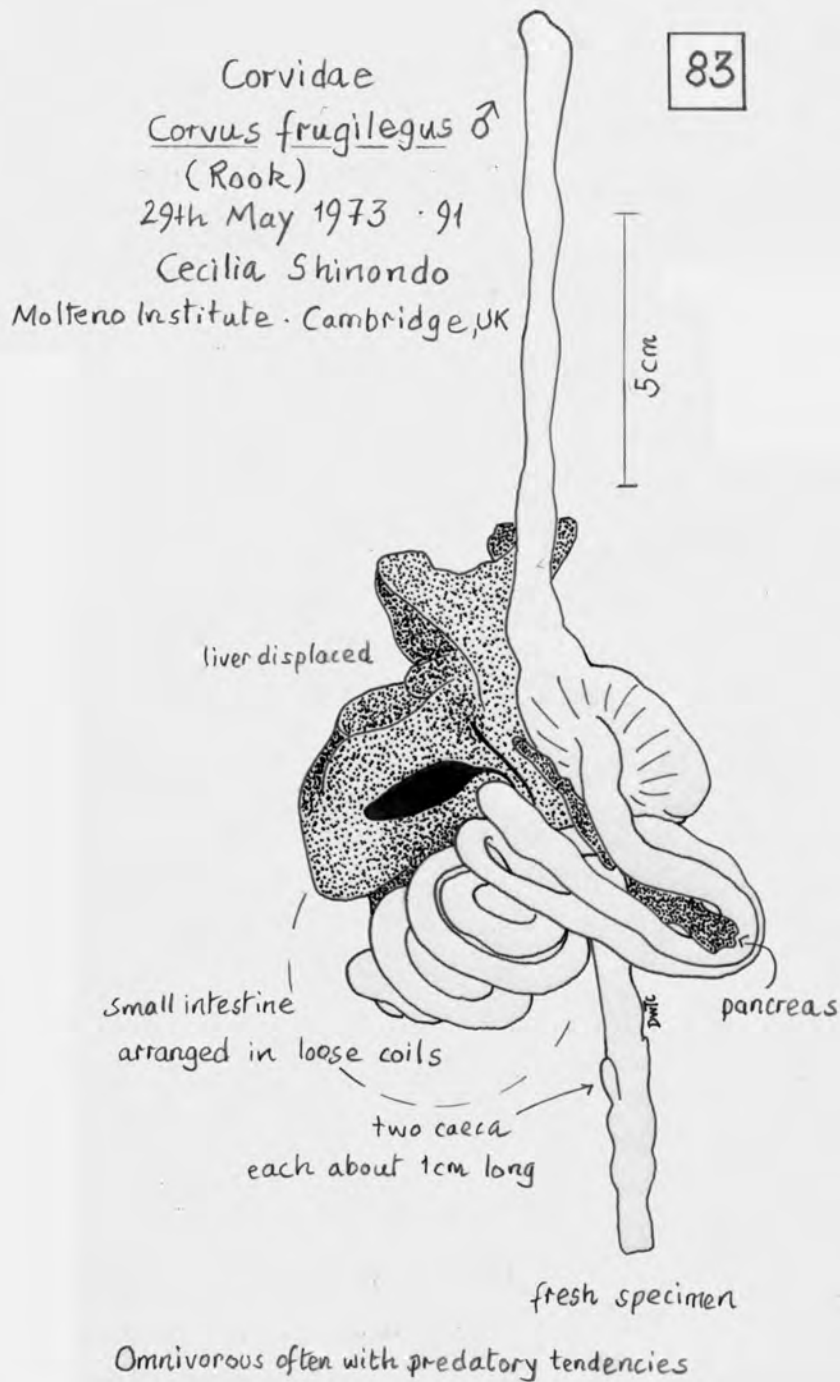


81 *Pica pica* (Black-billed Magpie/Magpie)



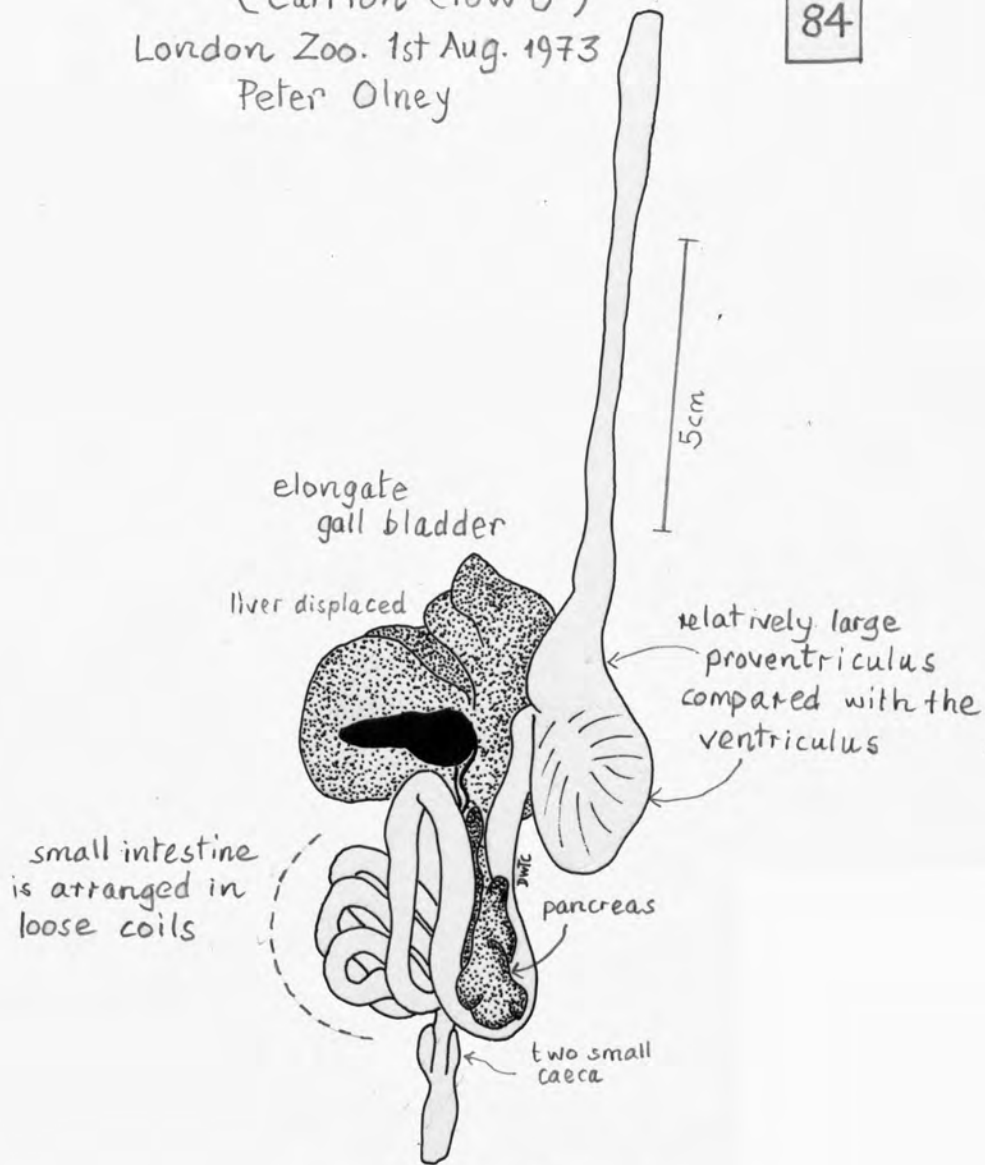
Omnivorous foraging on insects and plant foods





Corvidae: Corvus corone  
 (Carrion Crow ♂)  
 London Zoo. 1st Aug. 1973  
 Peter Olney

84

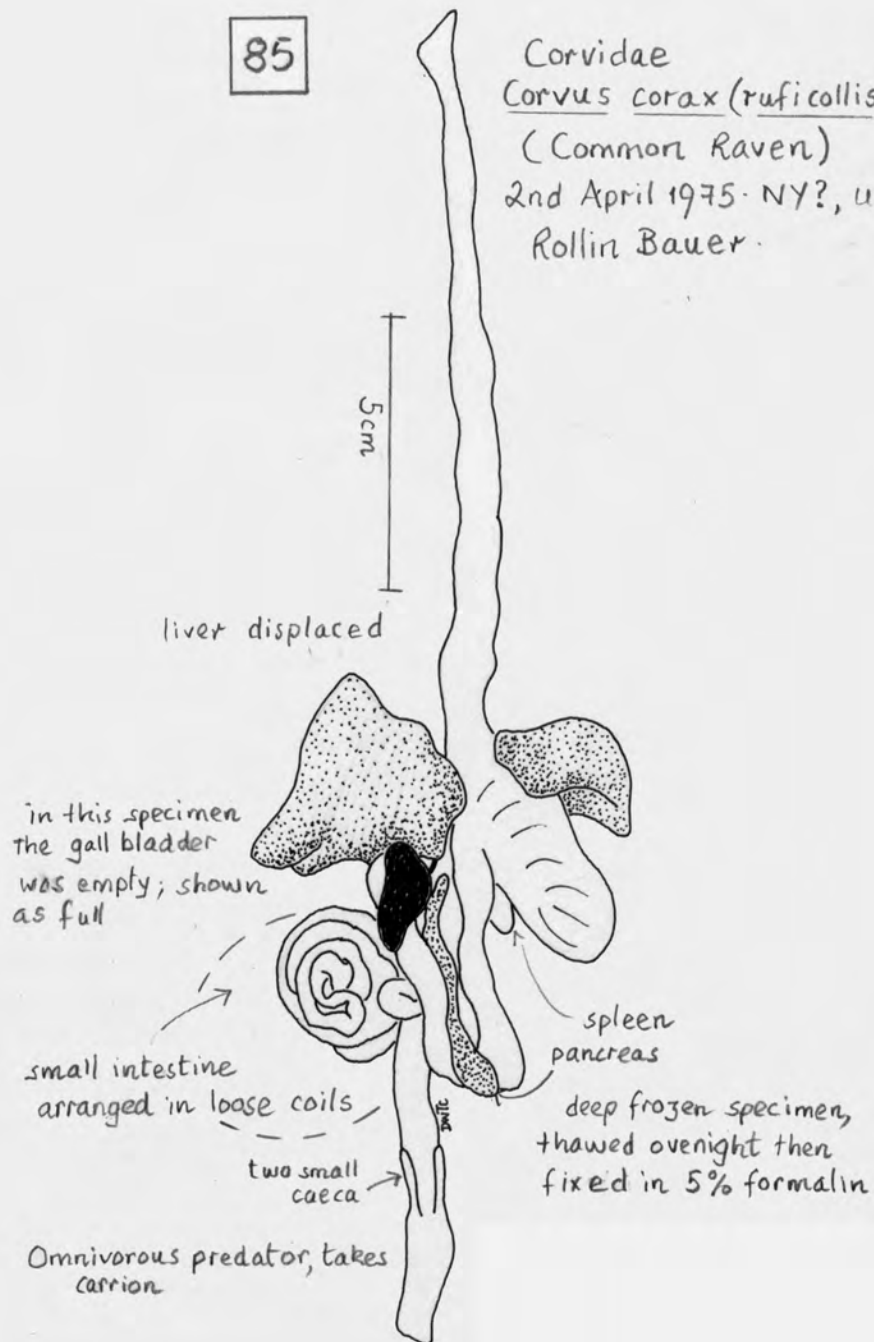


specimen received in 5% formalin

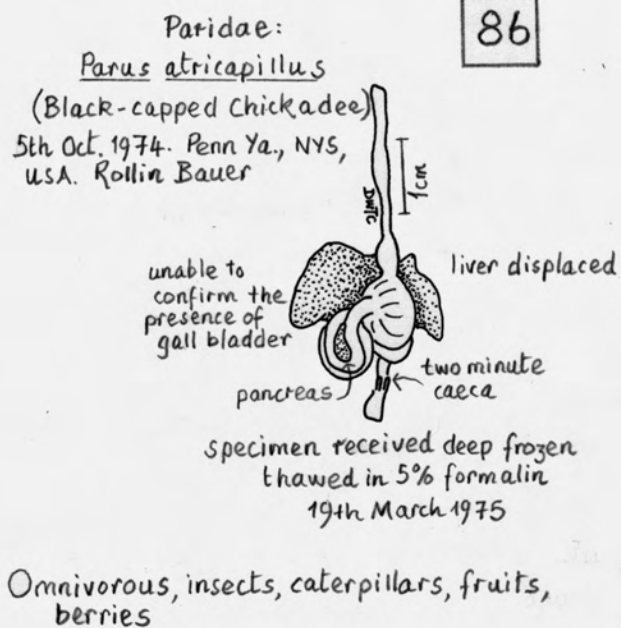
Omnivorous often with predatory tendencies

85

Corvidae  
Corvus corax (ruficollis)  
(Common Raven)  
2nd April 1975 · NY?, USA  
Rollin Bauer

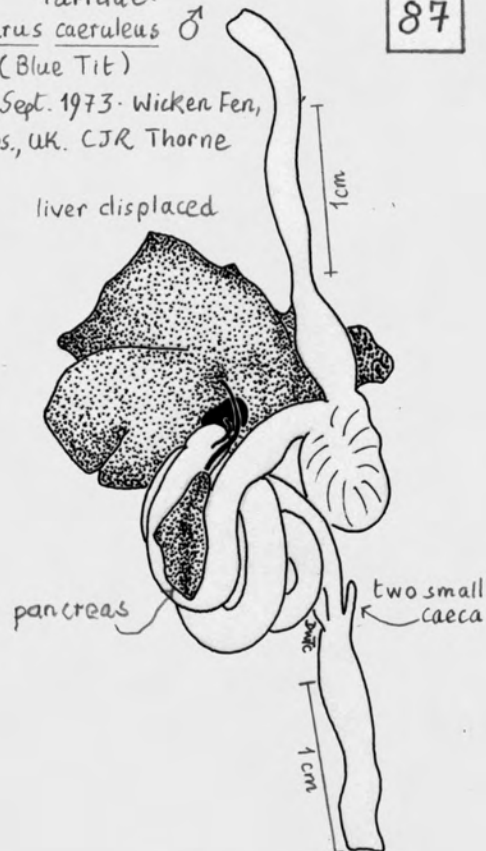


85 *Corvus corax (ruficollis)* (Common Raven)



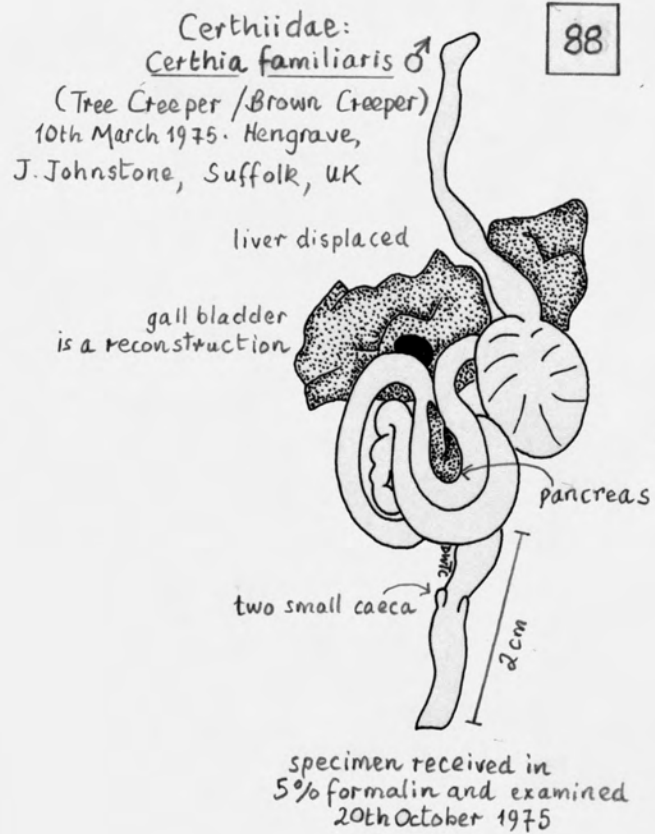
Paridae:  
Parus caeruleus ♂  
 (Blue Tit)  
 22nd Sept. 1973. Wicken Fen,  
 Cambs., UK. CJR Thorne

87

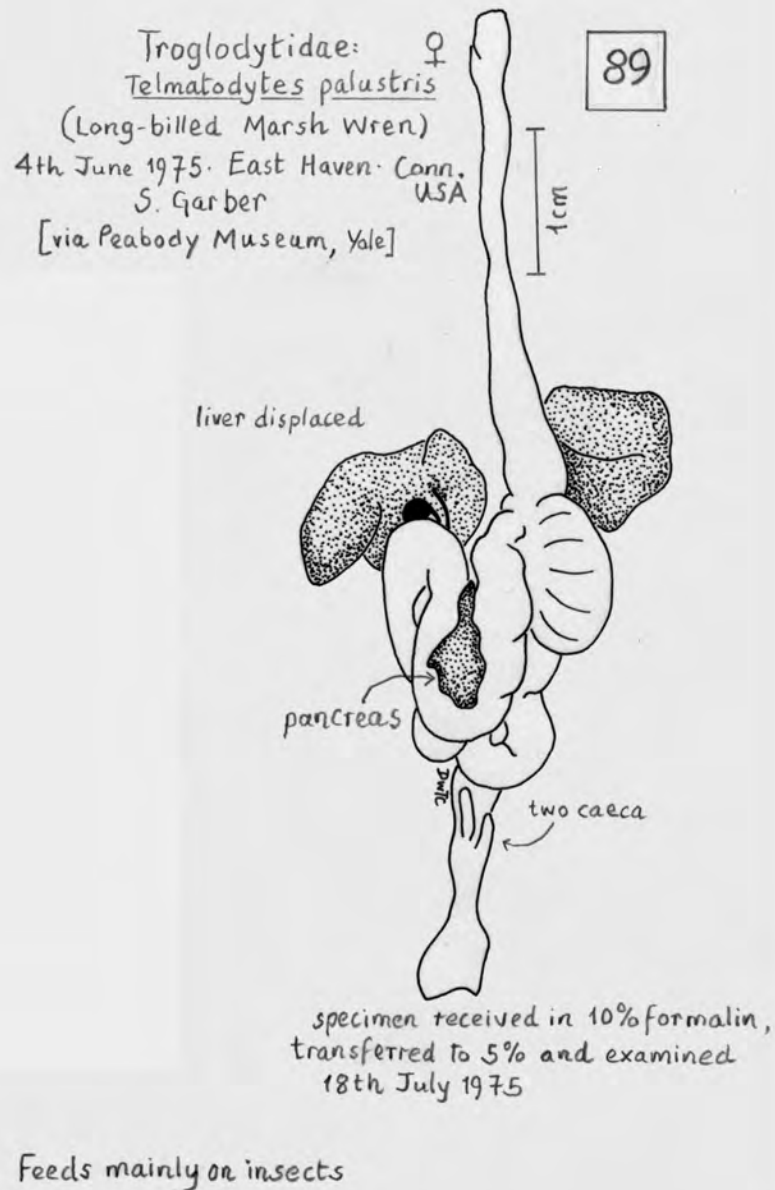


specimen fixed in 5% formalin

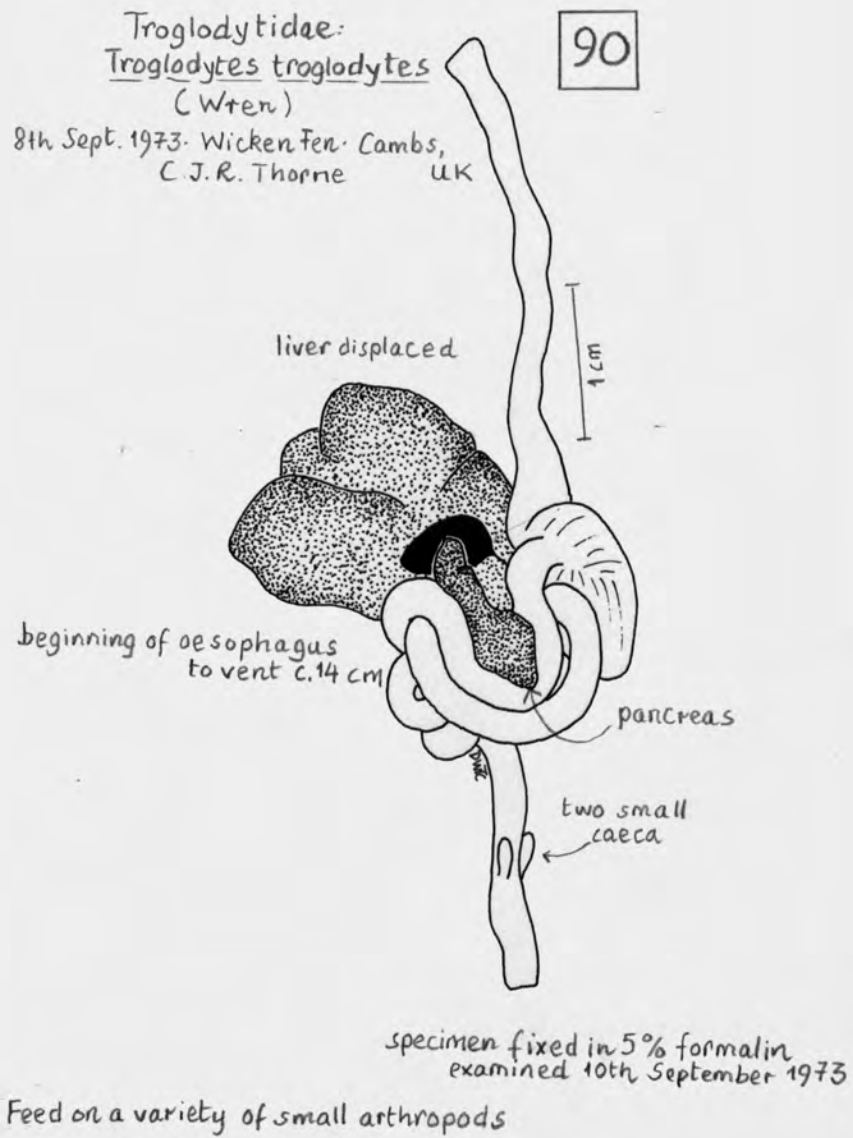
Omnivorous; feeding on insects, small invertebrates,  
 seeds, nuts



Diet mainly insects and spiders; plus seeds in winter



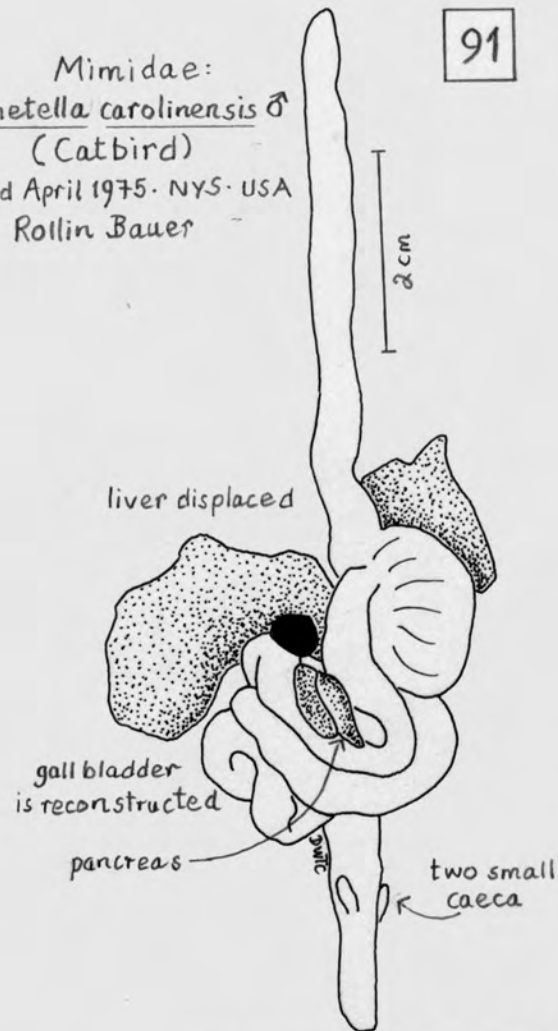




90 *Troglodytes troglodytes* (Wren)

Mimidae:  
*Dumetella carolinensis* ♂  
 (Catbird)  
 2nd April 1975. NYS. USA  
 Rollin Bauer

91

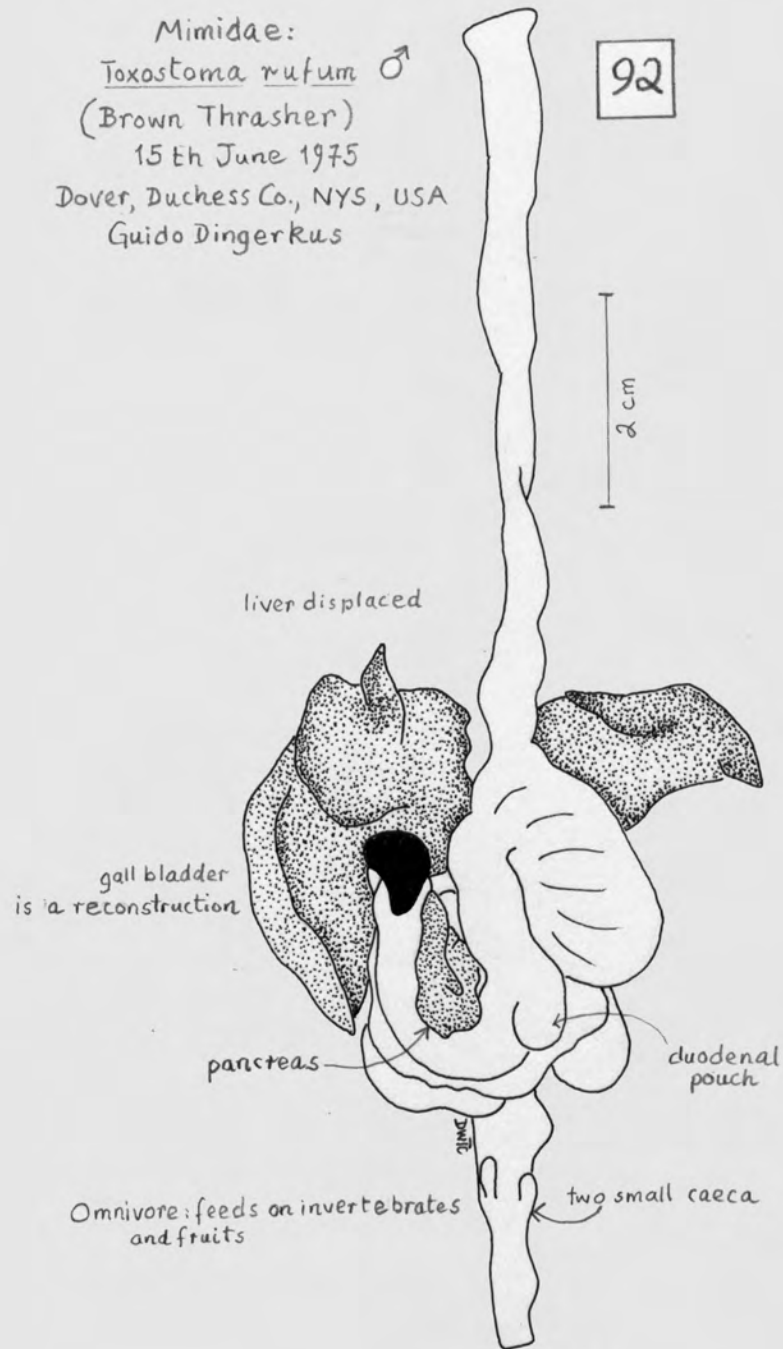


specimen received deep frozen  
 thawed in 5% formalin

Feed on a variety of invertebrates and fruits

Mimidae:  
*Toxostoma rufum* ♂  
 (Brown Thrasher)  
 15th June 1975  
 Dover, Dutchess Co., NYS, USA  
 Guido Dingerkus

92



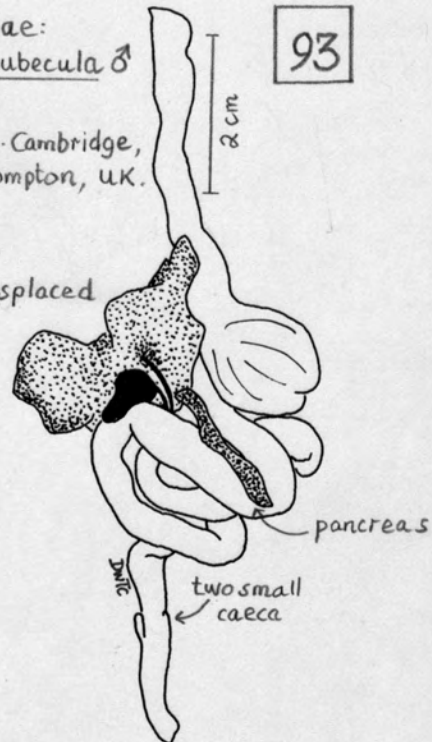
specimen received in  
 10% formalin, transferred to 5% formalin  
 examined 26th June 1975

92 *Toxostoma rufum* (Brown Thrasher)

Turdidae:  
*Erithacus rubecula* ♂  
 (Robin)  
 15th Sept. 1974 - Cambridge,  
 Virginia Crompton, U.K.

93

liver displaced

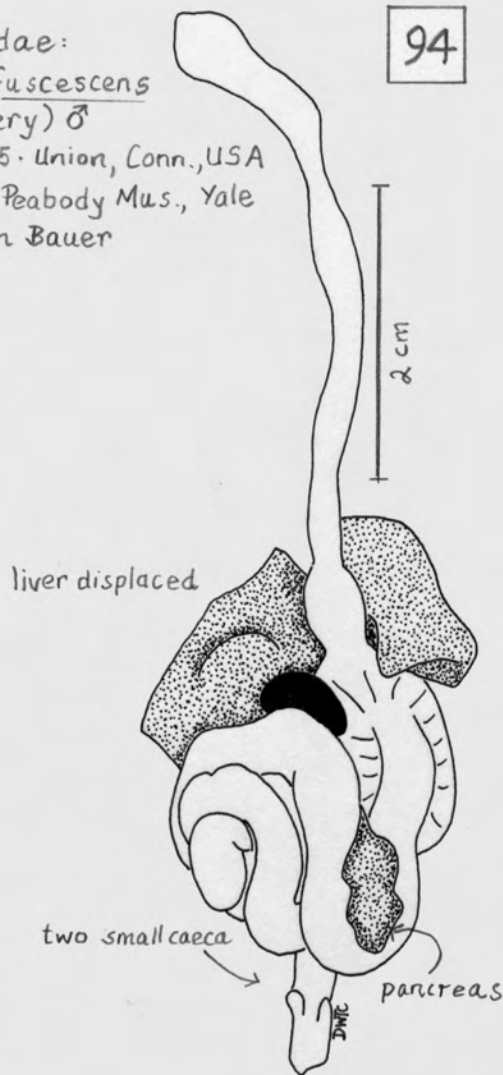


specimen found freshly dead  
 fixed in 5% formalin

Feed on insects, spiders, worms, berries,  
 fruits, seeds off bird tables

Turdidae:  
Catharus fuscescens  
 ( Veery) ♂  
 16th June 1975 · Union, Conn., USA  
 S. Garber, Peabody Mus., Yale  
 Rollin Bauer

94

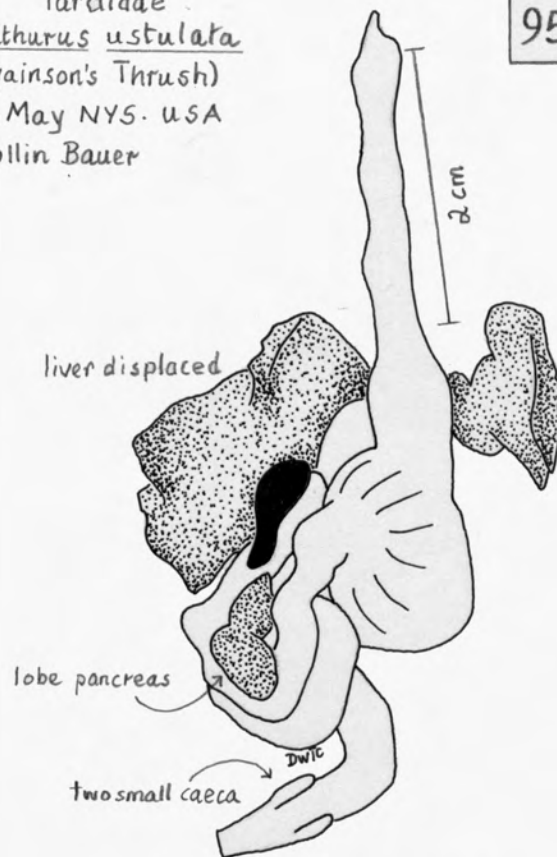


specimen received in 10% formalin  
 18th July 1975; transferred to  
 5% formalin

Omnivore, diet includes seeds, insects, fruit

Turdidae  
*Catharus ustulata*  
 (Swainson's Thrush)  
 14th May NYS. USA  
 Rollin Bauer

95



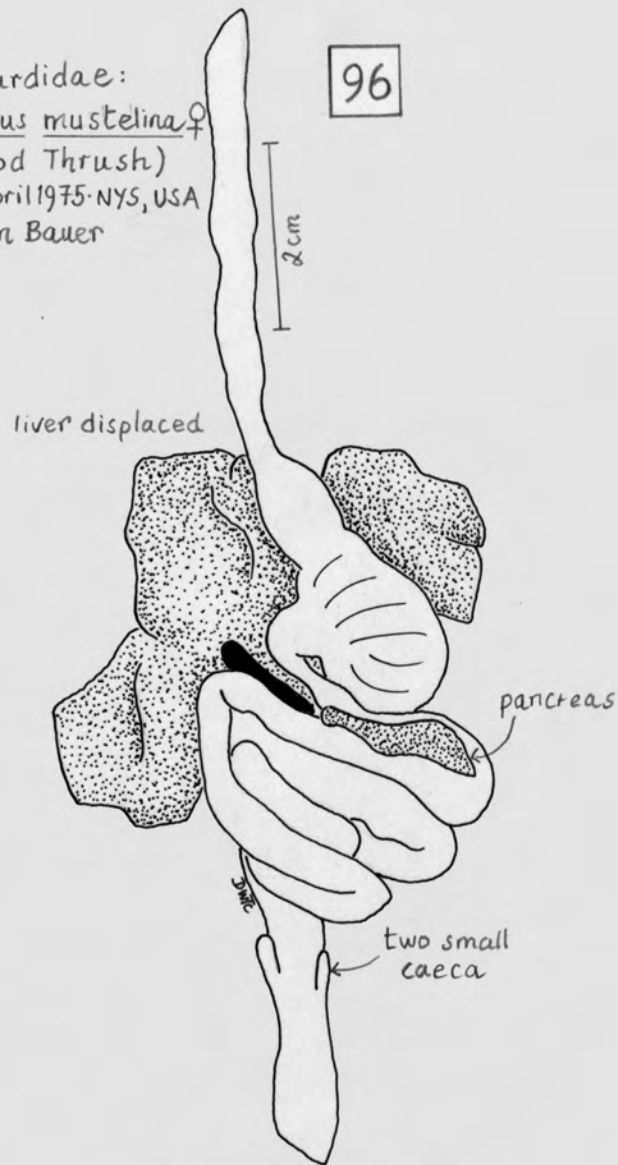
specimen received deep frozen  
 thawed in 5% formalin

Omnivore: diet of earthworms, insects, fruit



Turdidae:  
Catharus mustelina ♀  
(Wood Thrush)  
2nd April 1975, NYS, USA  
Rollin Bauer

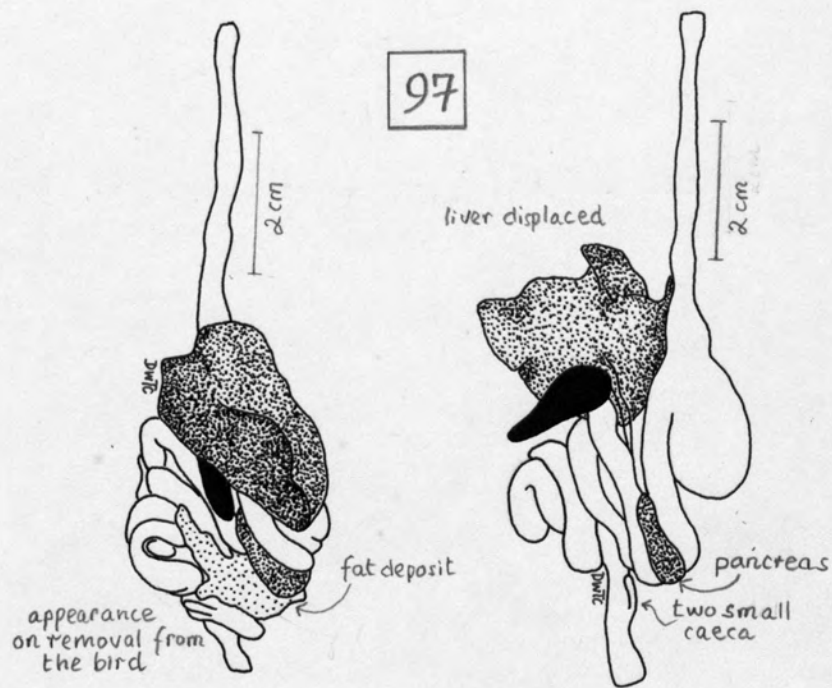
96



specimen received deep frozen  
thawed in 5% formalin

Omnivorous; soil invertebrates, larvae, insects, fruits





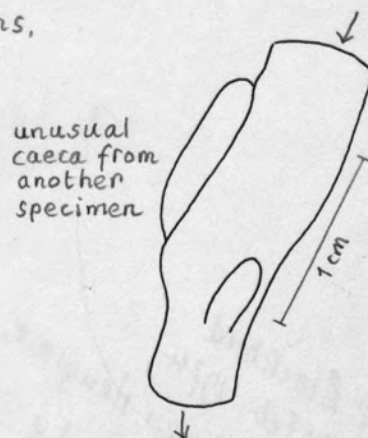
Turdidae:  
Turdus merula ♀  
 (Blackbird)

14th February 1974 · Hengrave, Suffolk, UK

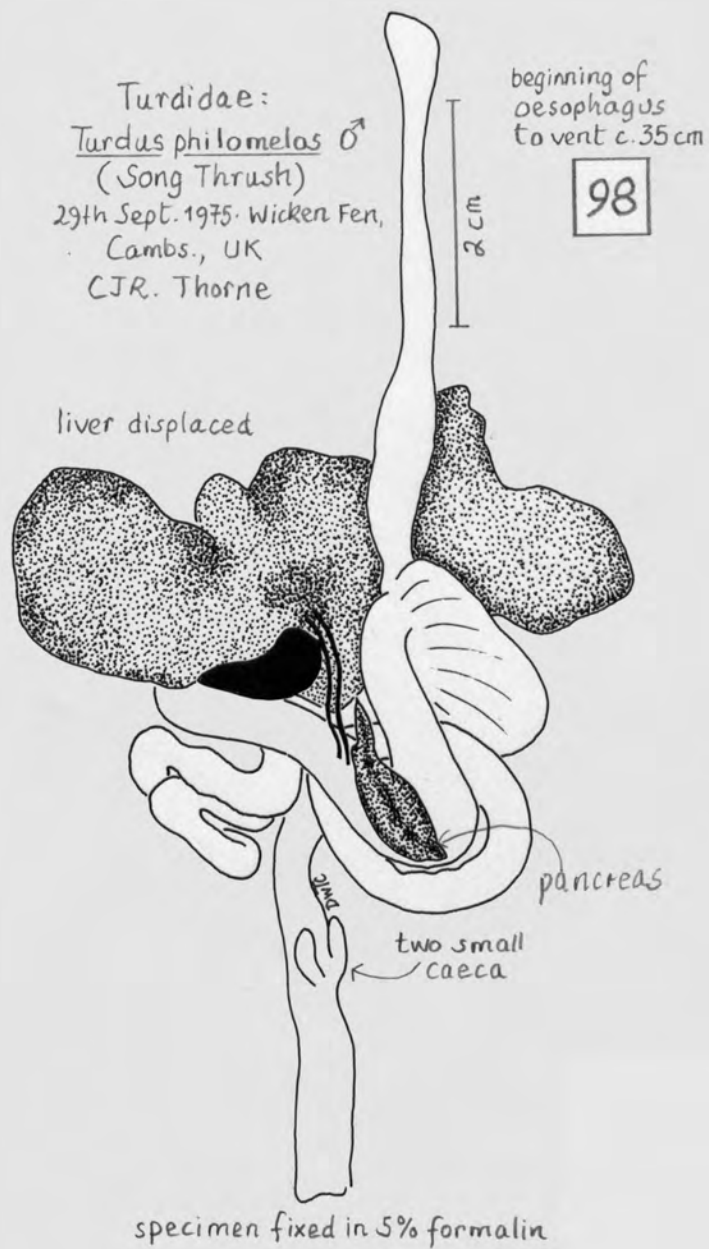
J. Johnstone

specimens received in 5% formalin

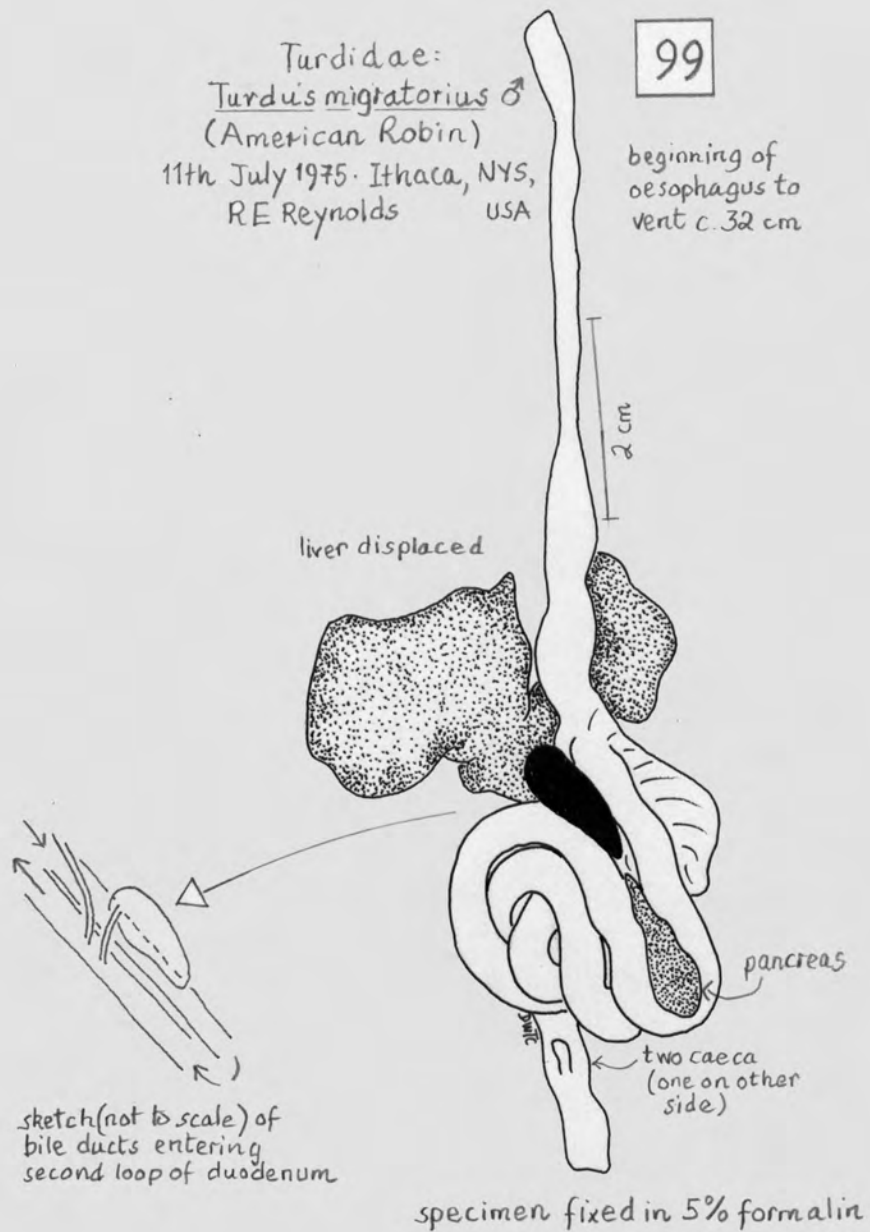
Omnivore: diet includes earthworms,  
 invertebrates, fruits



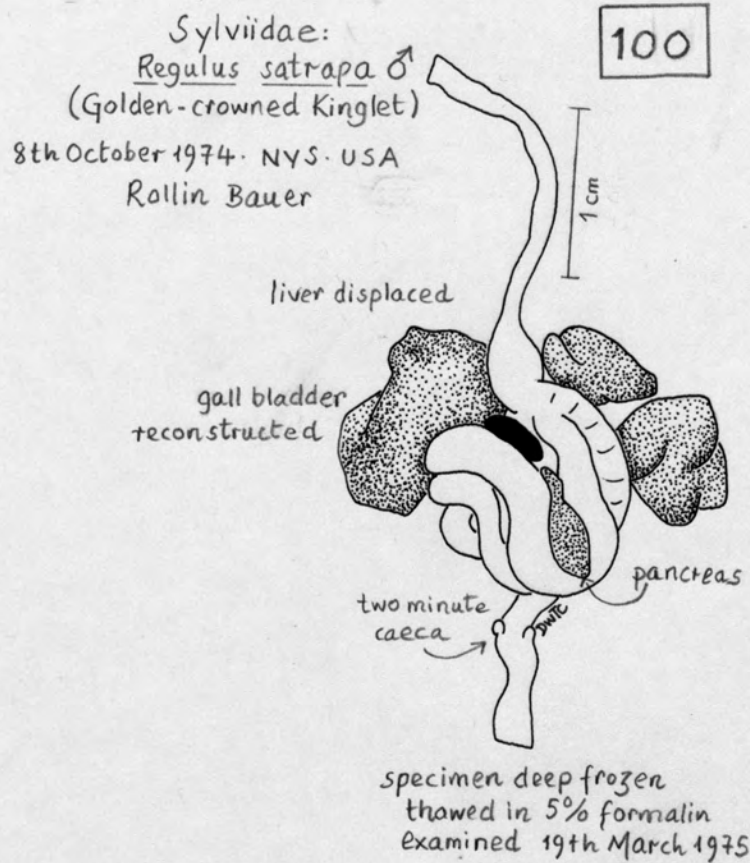
97 *Turdus merula* (Blackbird)



Feed on earthworms, snails, berries, fruits



Feed on insects, earthworms, berries, fruits

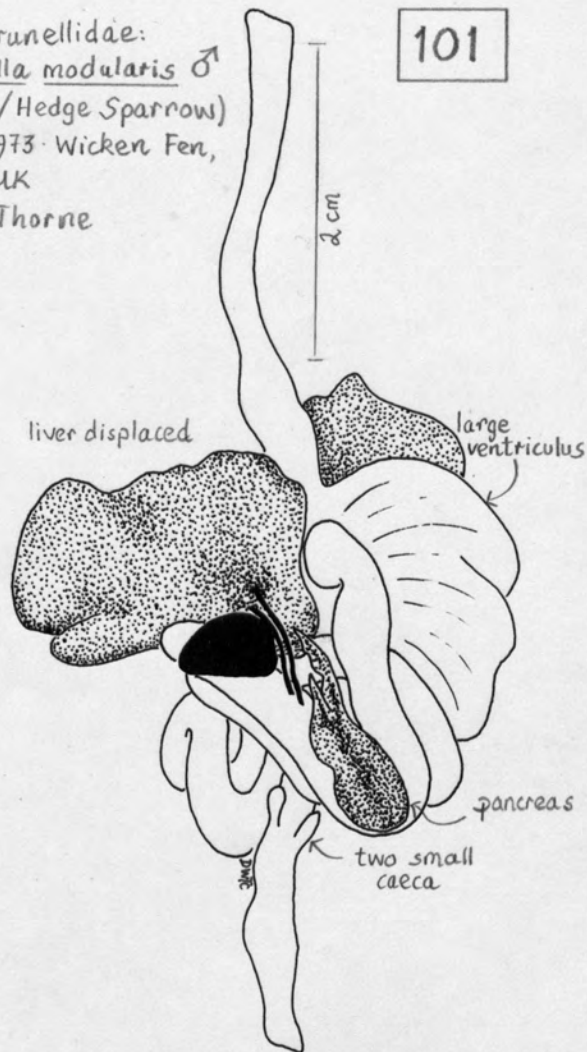


Insectivore; diet includes insects with soft  
 cuticles such as aphids and springtails



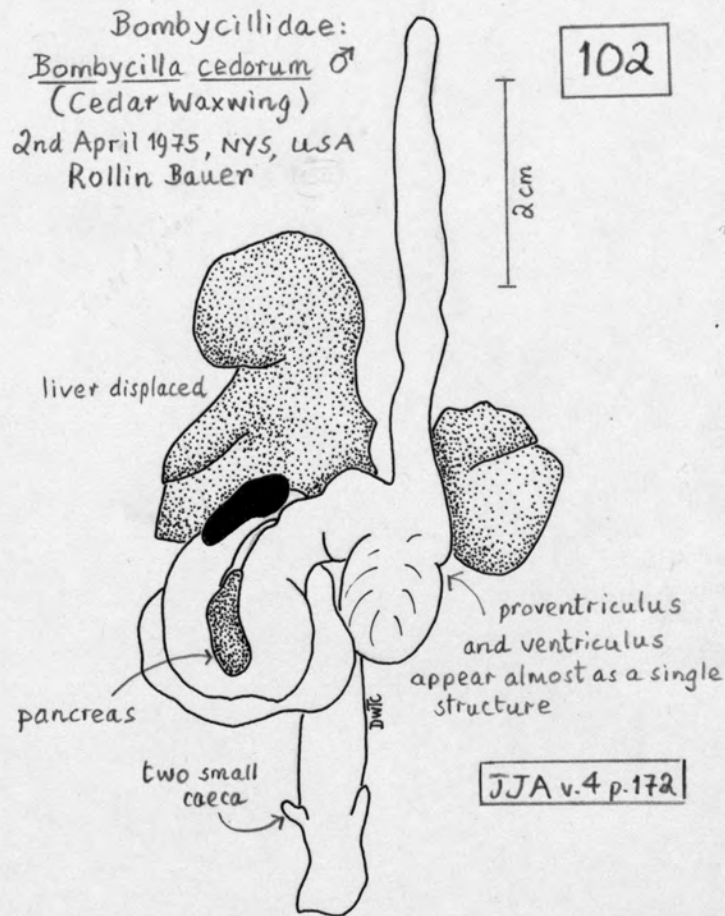
Prunellidae:  
*Prunella modularis* ♂  
 (Dunnoch/Hedge Sparrow)  
 29th Sept. 1973 · Wicken Fen,  
 Cambs. UK  
 C.J.R. Thorne

101



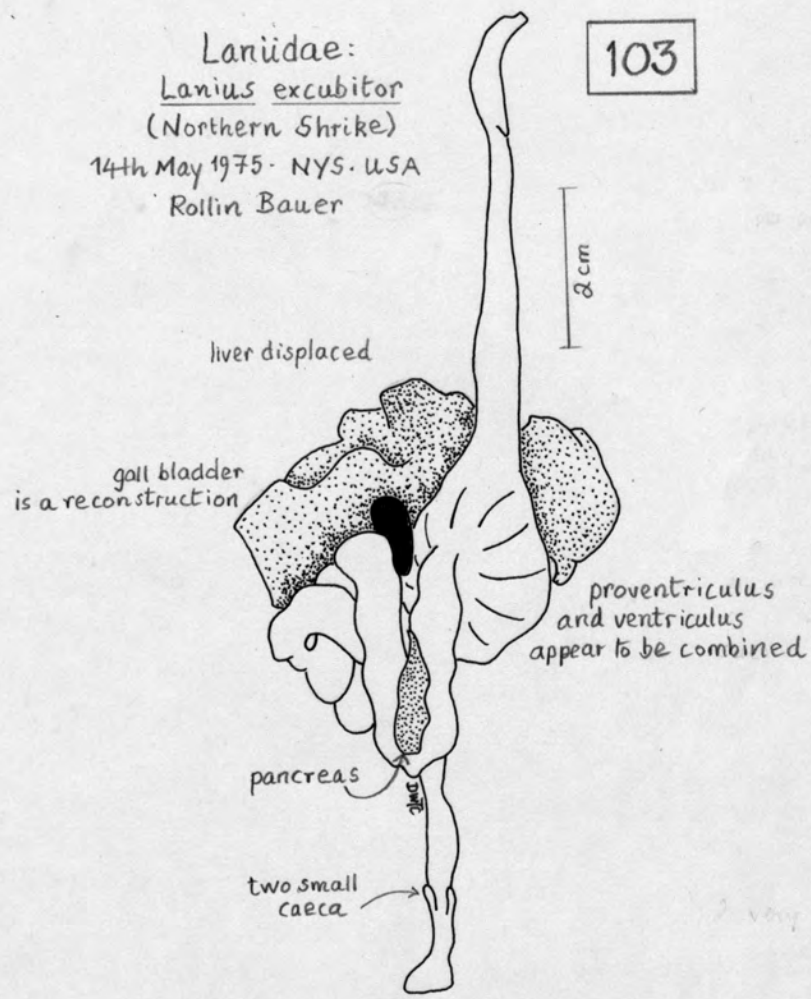
specimen fixed in 5% formalin

Feed on insects, seeds



specimen received deep frozen  
 thawed in 5% formalin

Omnivorous; fruits, berries, insects



specimen received in  
5% formalin

Carnivore feeding on small birds and small mammals

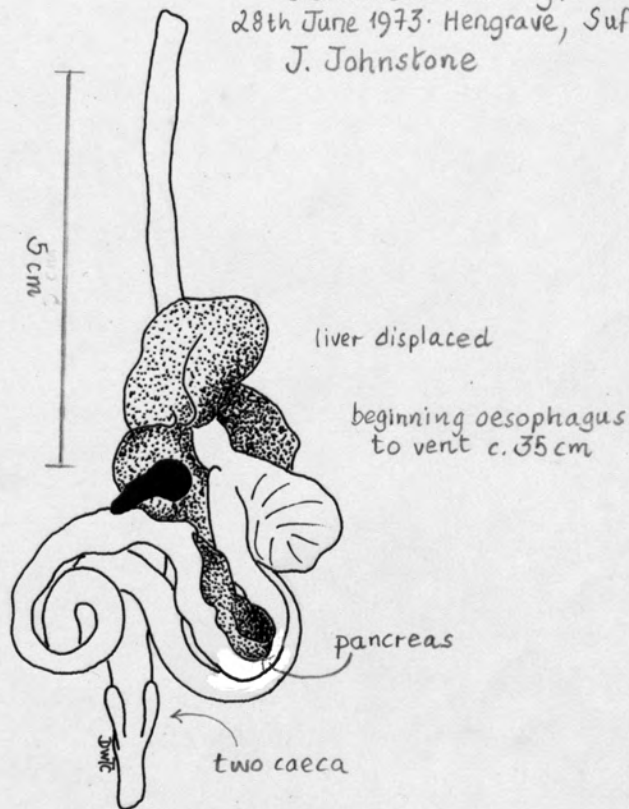


104

Sturnidae:

*Sturnus vulgaris* ♂  
(Common Starling)

28th June 1973. Hengrave, Suffolk, UK  
J. Johnstone

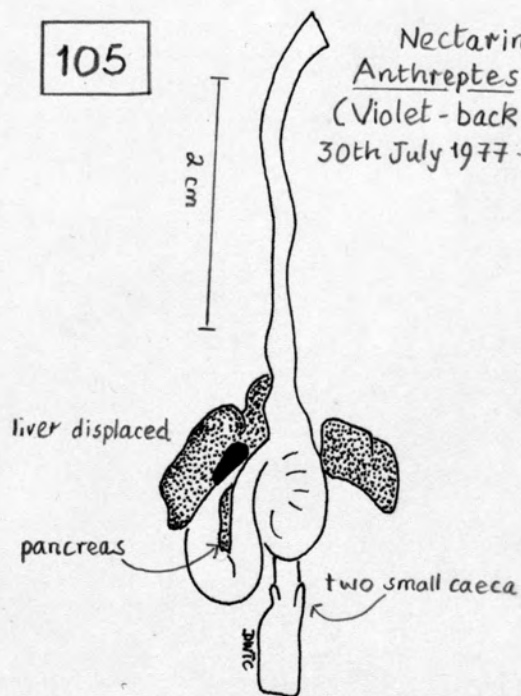


Omnivore: diet of a wide variety of insects,  
earthworms, seeds, fruits, berries

104 *Sturnus vulgaris* (Common Starling)

105

Nectariniidae:  
Anthreptes longuemarei ♂  
(Violet-backed Sunbird)  
30th July 1977 - Moru Ethez, Kenya

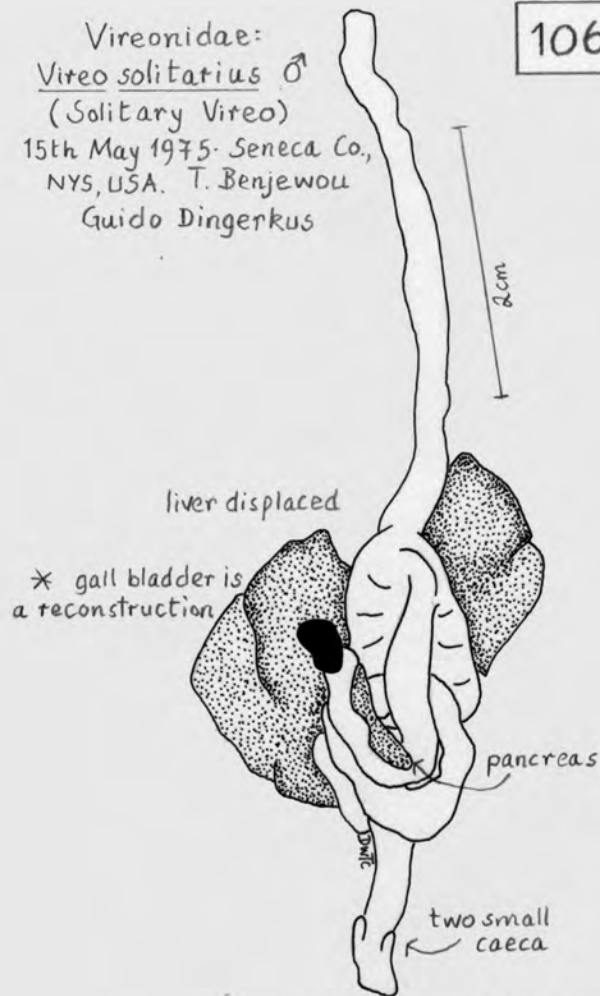


fresh specimen fixed  
in 5% formalin on receipt

Feed mainly on nectar, but also take insects and spiders

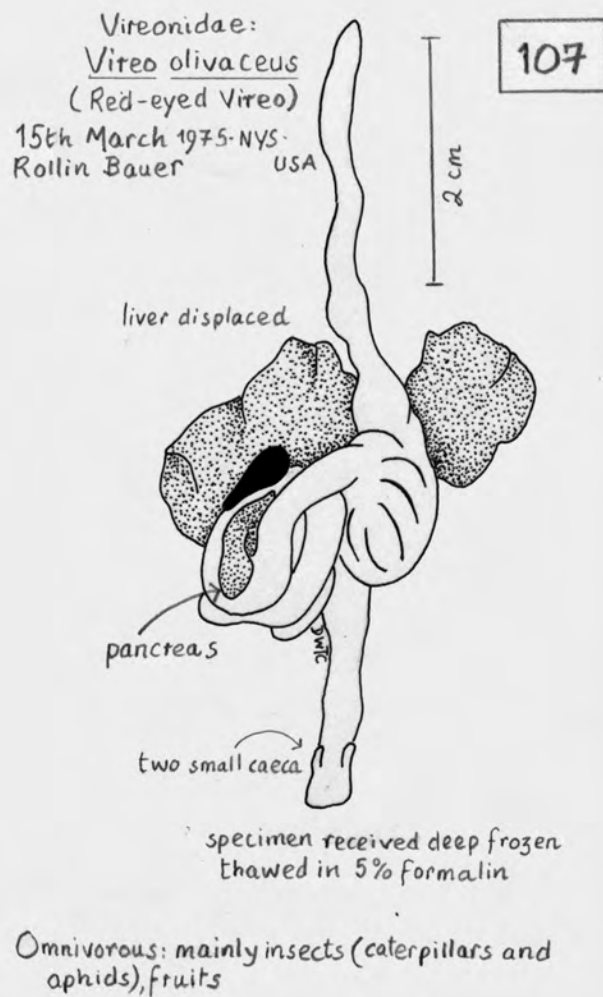
Vireonidae:  
*Vireo solitarius* ♂  
 (Solitary Vireo)  
 15th May 1975. Seneca Co.,  
 NYS, USA. T. Benjewou  
 Guido Dingerkus

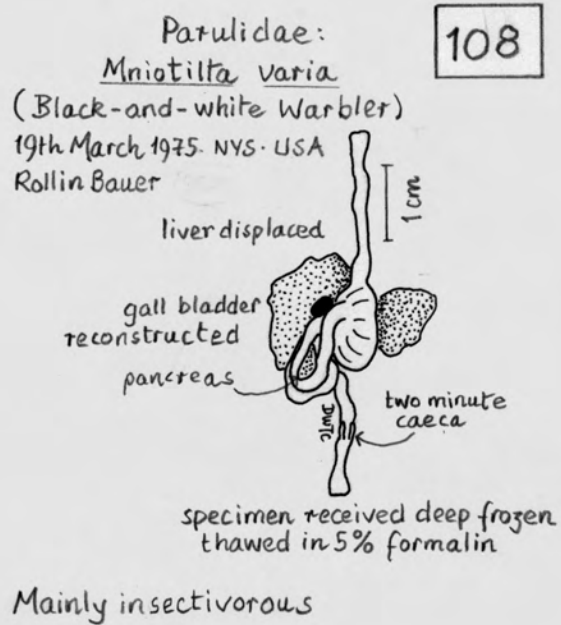
106



specimen received in 10% formalin  
 transferred to 5% formalin  
 [\* in a poor state of preservation]

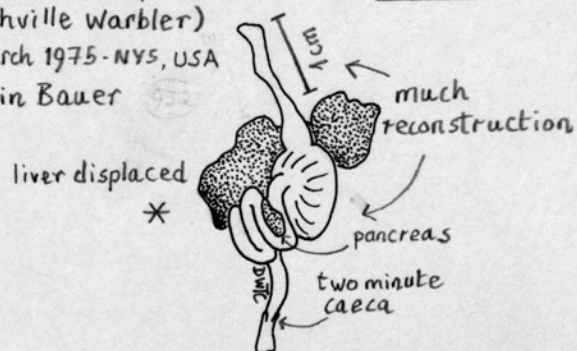
Omnivorous; mainly insects (caterpillars and  
 aphids), fruits





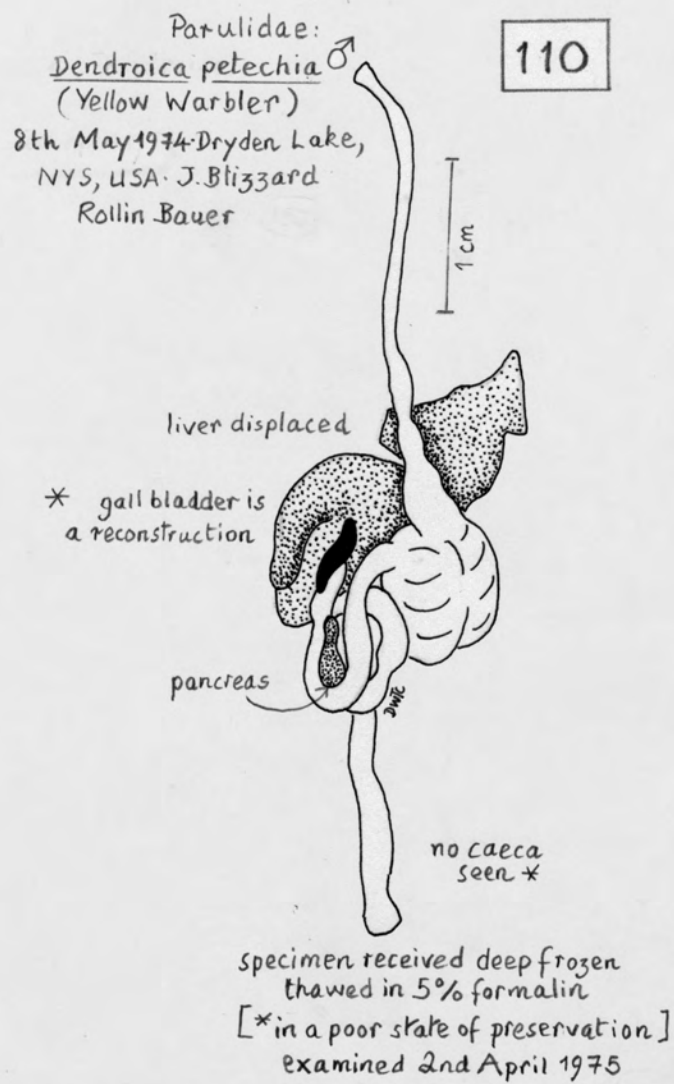
Parulidae:  
*Vermivora ruficapilla*  
 (Nashville Warbler)  
 19th March 1975 - NYS, USA  
 Rollin Bauer 952

109



specimen received deep frozen  
 thawed in 5% formalin  
 [\*in a very poor state of preservation]

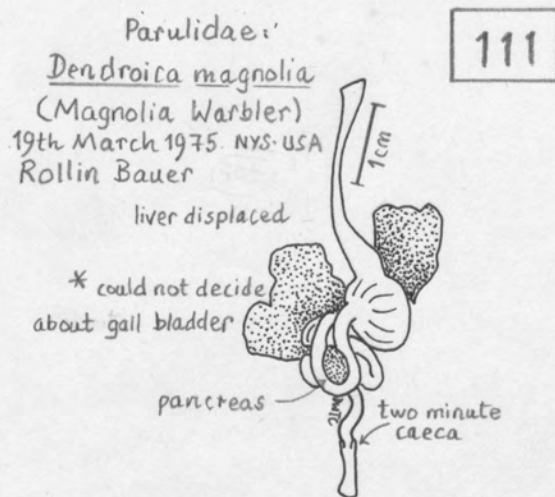
Feeds mainly on insects - some seeds and berries



Mainly insectivorous

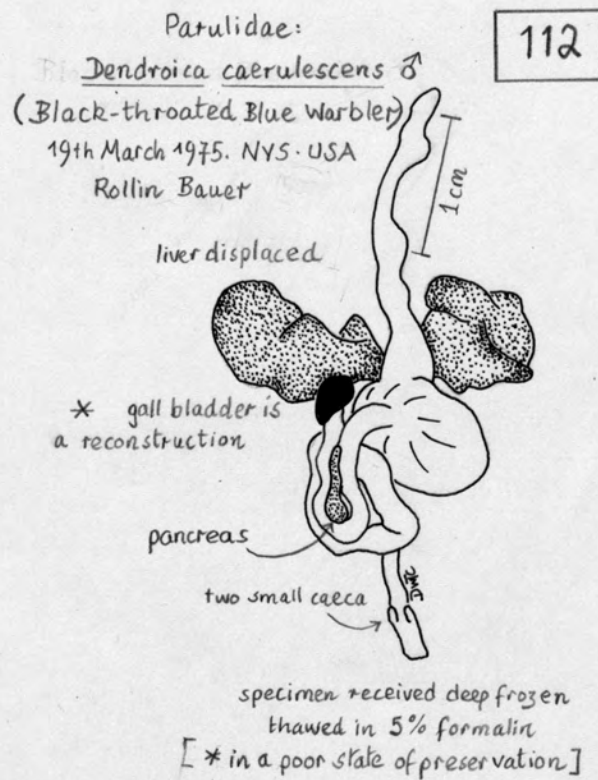
110 *Dendroica petechia* (Yellow Warbler)





specimen received deep frozen  
thawed in 5% formalin  
[\* in a poor state of preservation]

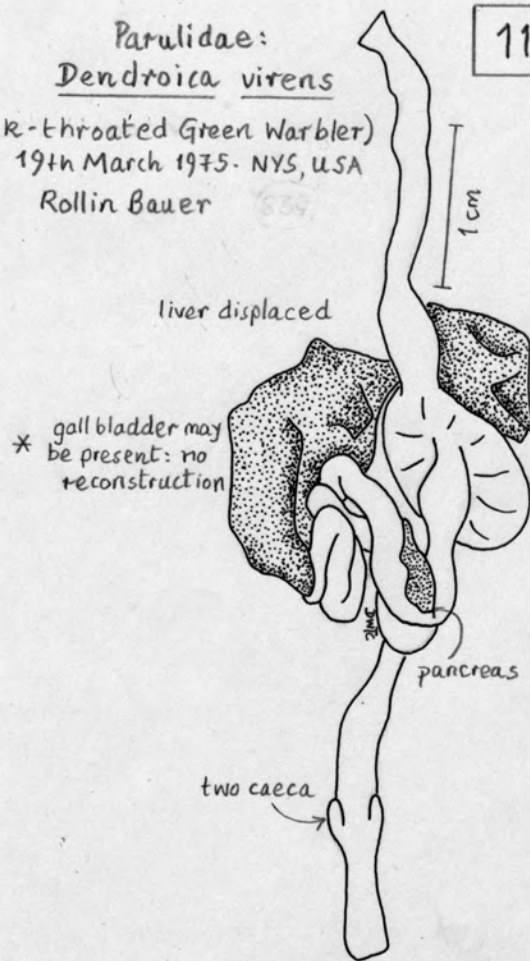
Feeds mainly on insects - also takes fruits, nectar



Mainly insectivorous

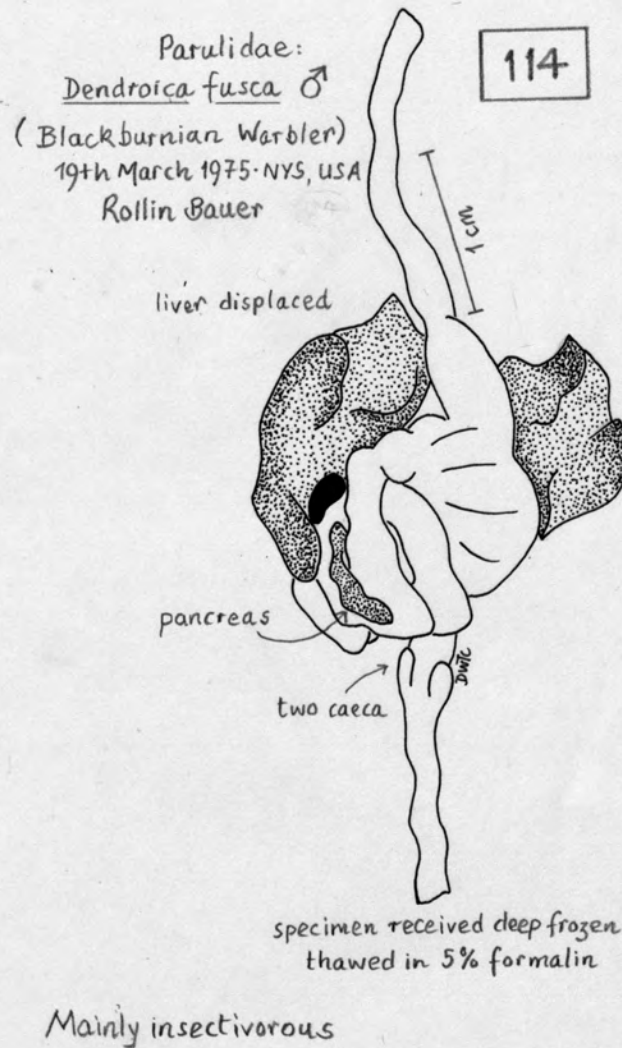
Parulidae:  
Dendroica virens  
 (Black-throated Green Warbler)  
 19th March 1975. NYS, USA  
 Rollin Bauer

113



specimen received deep frozen  
 thawed in 5% formalin  
 [\* in poor state of preservation]

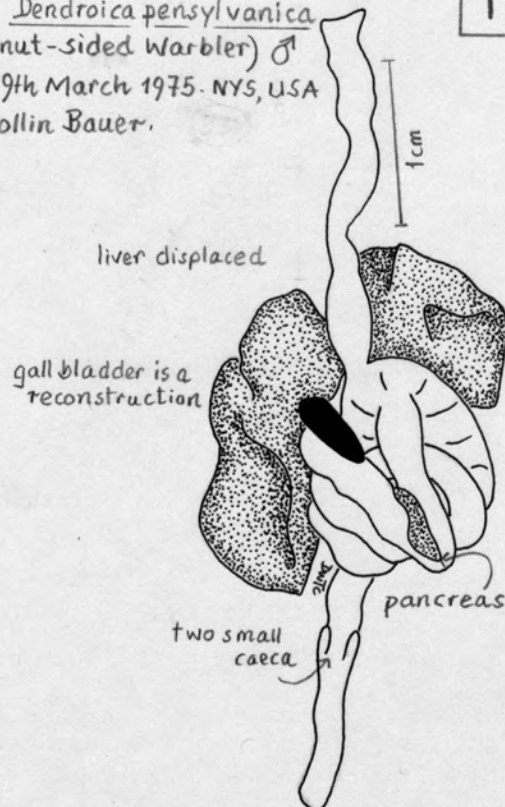
Mainly insectivorous



114 *Dendroica fusca* (Blackburnian Warbler)

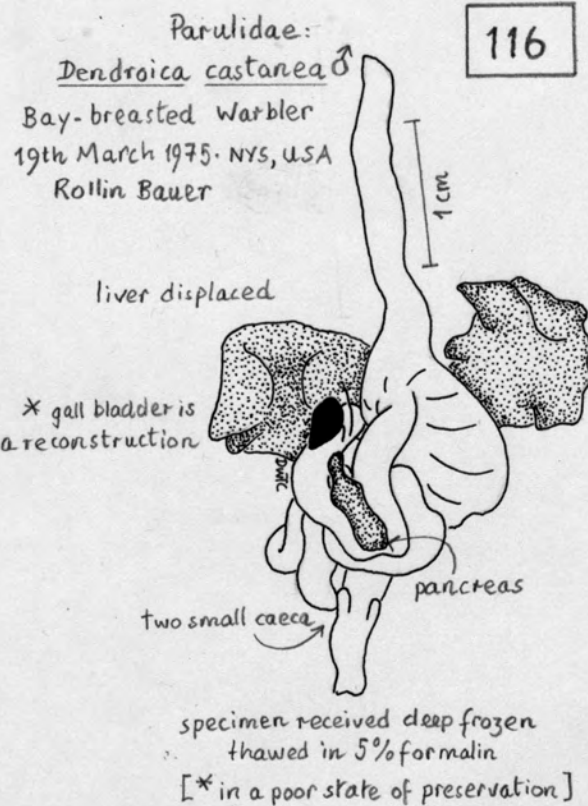
Parulidae:  
*Dendroica pensylvanica*  
 (Chestnut-sided Warbler) ♂  
 19th March 1975. NYS, USA  
 Rollin Bauer.

115



specimen received in 5% formalin  
 thawed in 5% formalin

Mainly insectivorous



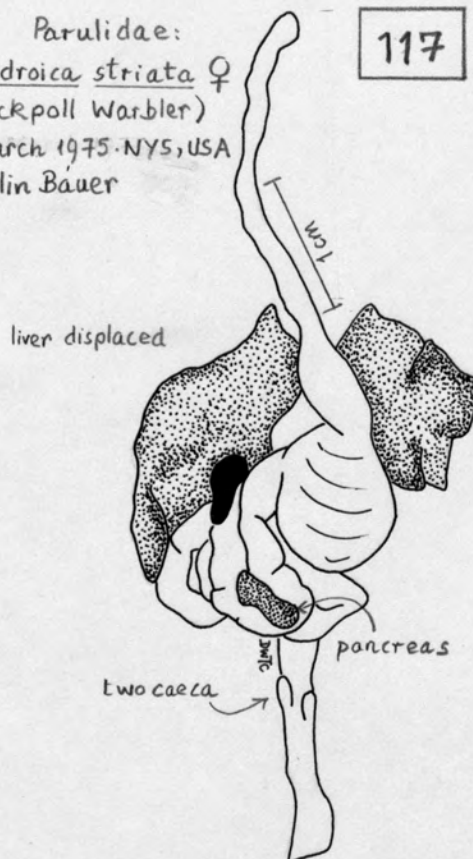
Mainly insectivorous

116 *Dendroica castanea* (Bay-breasted Warbler)



Parulidae:  
Dendroica striata ♀  
 (Blackpoll Warbler)  
 19th March 1975 - NYS, USA  
 Rollin Bauer

117



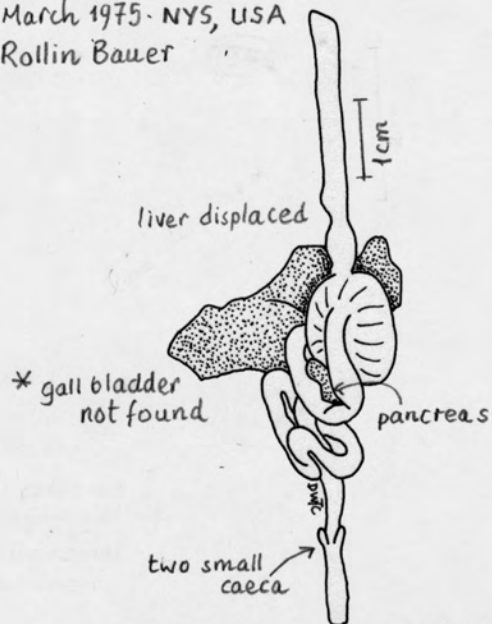
specimen received deep frozen  
 thawed in 5% formalin

Mainly insectivorous



Parulidae:  
Seiurus aurocapillus  
 (Oven Bird)  
 19th March 1975 · NYS, USA  
 Rollin Bauer

118

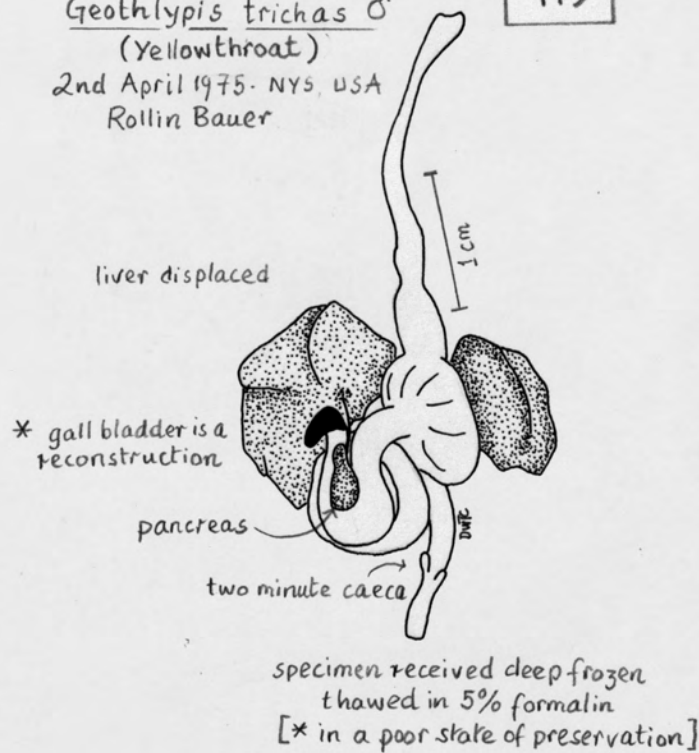


specimen received deep frozen  
 thawed in 5% formalin  
 [\*in a poor state of preservation]

Feed mainly on insects, may take small berries

Parulidae:  
Geothlypis trichas ♂  
 (Yellowthroat)  
 2nd April 1975. NYS, USA  
 Rollin Bauer

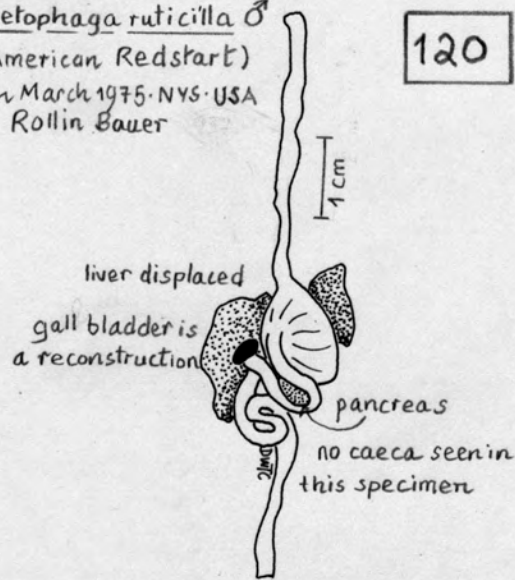
119



Mainly insectivorous

Parulidae:  
*Setophaga ruticilla* ♂  
(American Redstart)  
19th March 1975 · NYS · USA  
Rollin Bauer

120



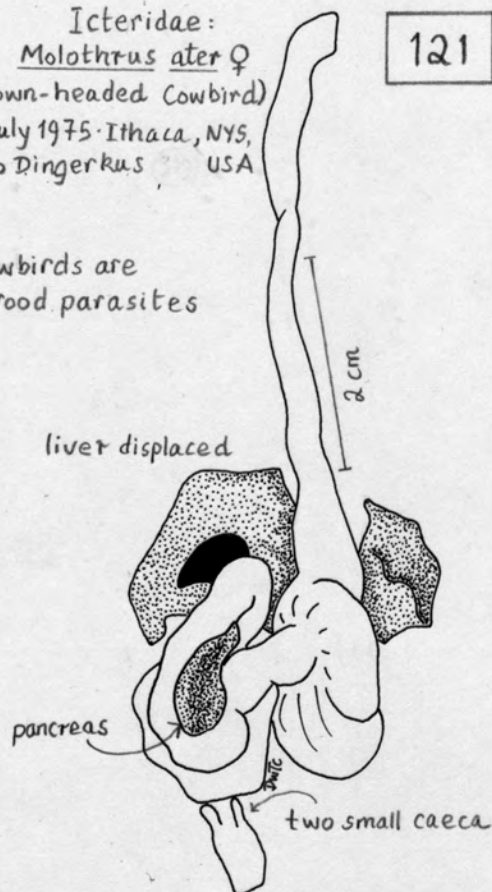
specimen received deep frozen  
thawed in 5% formalin

Feeds almost entirely on insects

Icteridae:  
*Molothrus ater* ♀  
 (Brown-headed Cowbird)  
 30th July 1975 · Ithaca, NYS,  
 Guido Dingerkus USA

121

Cowbirds are  
 brood parasites



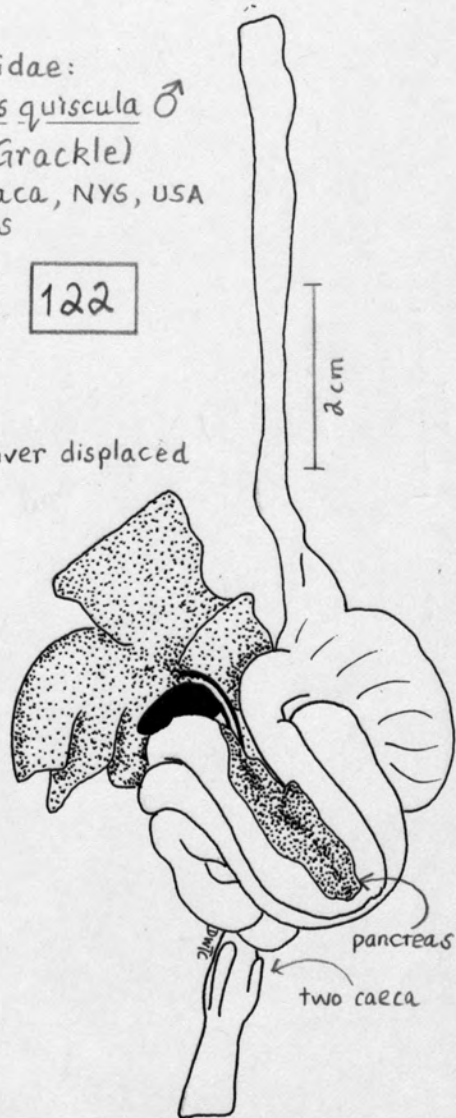
specimen received in 5% formalin

Ground feeders ; diet includes insects, seeds

Icteridae:  
Quiscalus quiscula ♂  
(Common Grackle)  
9th July 1974 · Ithaca, NYS, USA  
RE Renolds

122

liver displaced



specimen fixed  
in 5% formalin

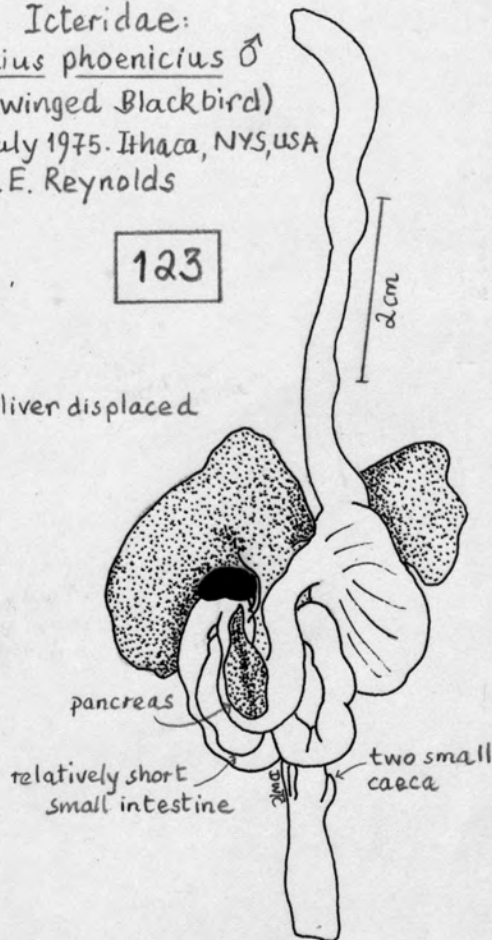
Omnivore: insects, seeds, fruits, grain

122 *Quiscalus quiscula* (Common Grackle)

Icteridae:  
Agelaius phoeniceus ♂  
 (Red-winged Blackbird)  
 11th July 1975. Ithaca, NYS, USA  
 R.E. Reynolds

123

liver displaced

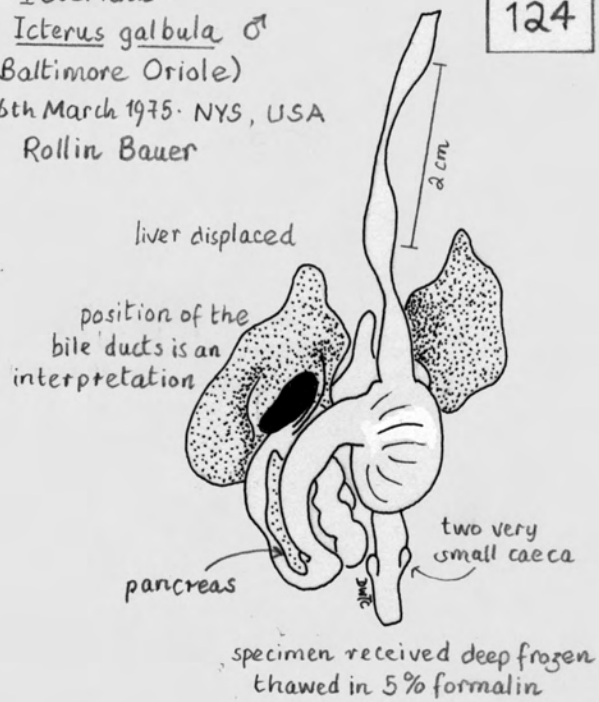


specimen fixed in 5% formalin

Omnivorous; feeding on seeds, insects, spiders,  
 frogs, snails, carrion, berries

Icteridae:  
*Icterus galbula* ♂  
 (Baltimore Oriole)  
 26th March 1975 · NYS, USA  
 Rollin Bauer

124



Omnivorous feeding on insects, berries, nectar

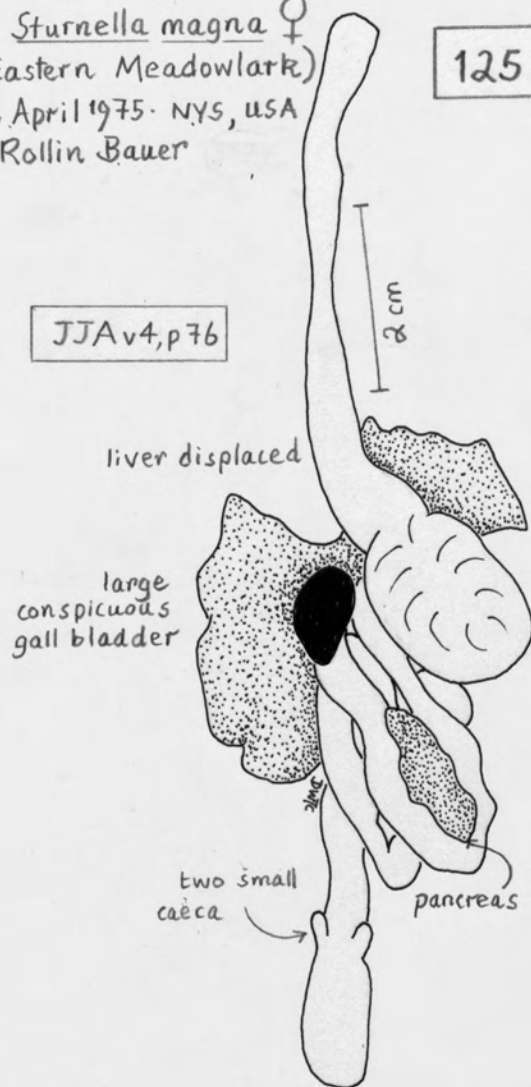
JJA v.4, p.42



Icteridae:  
*Sturnella magna* ♀  
 (Eastern Meadowlark)  
 2nd April 1975. NYS, USA  
 Rollin Bauer

125

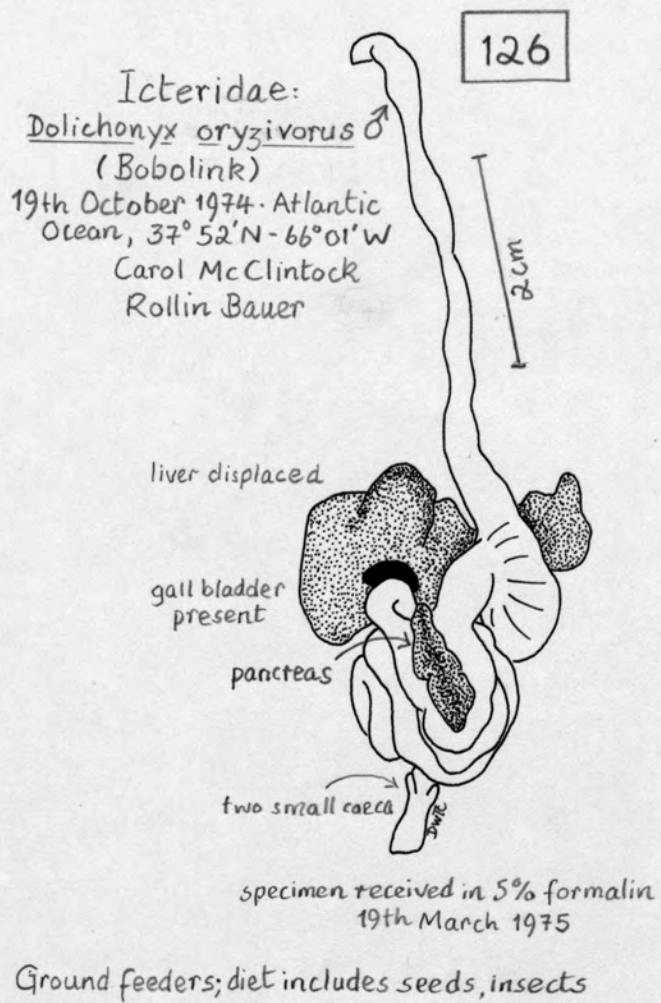
JJA v4, p76



specimen received deep frozen,  
 thawed in 5% formalin

Foraging on the ground to feed on  
 worms, insects, seeds, fruits

125 *Sturnella magna* (Eastern Meadowlark)

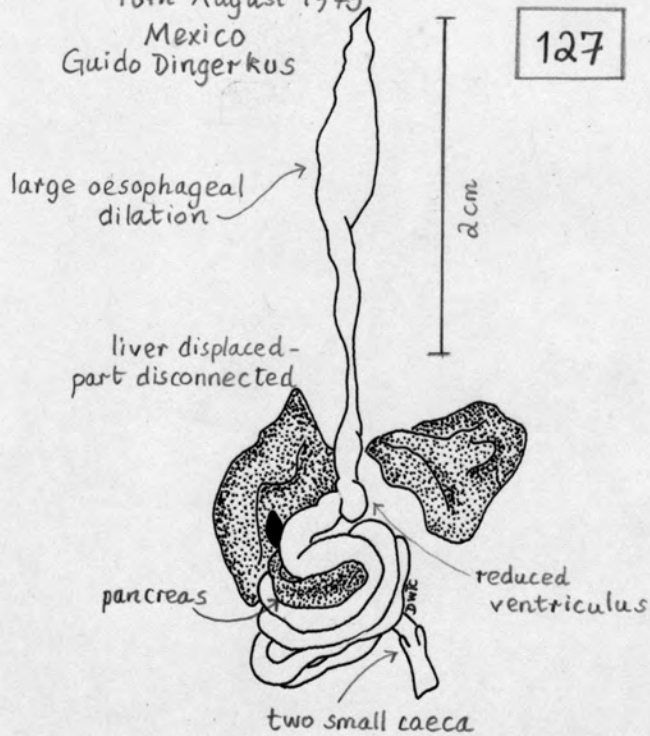


126 *Dolichonyx oryzivorus* (Bobolink)

127

Thraupidae:  
*Euphonia hirudinacea* ♂  
 (Yellow-throated Euphonia)  
 16th August 1975  
 Mexico  
 Guido Dingerkus

127

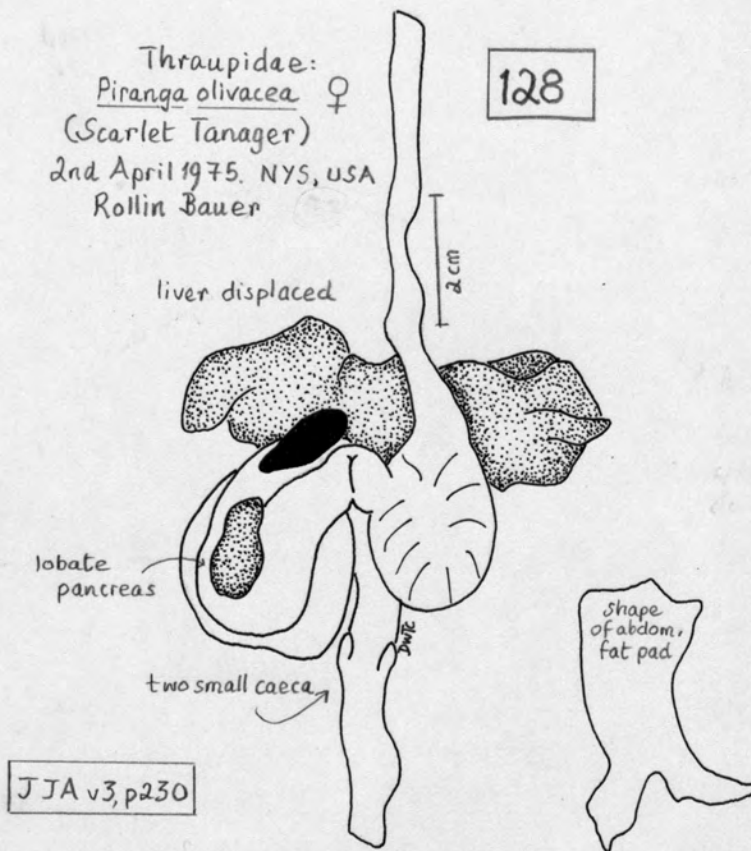


specimen received in 10% formalin,  
 transferred to 5% formalin,  
 examined in March 1976

Omnivore: diet of insects, small fruits, mistletoe berries

Thraupidae:  
*Piranga olivacea* ♀  
 (Scarlet Tanager)  
 2nd April 1975. NYS, USA  
 Rollin Bauer

128



JJA v3, p230

specimen received deep frozen  
 thawed in 5% formalin

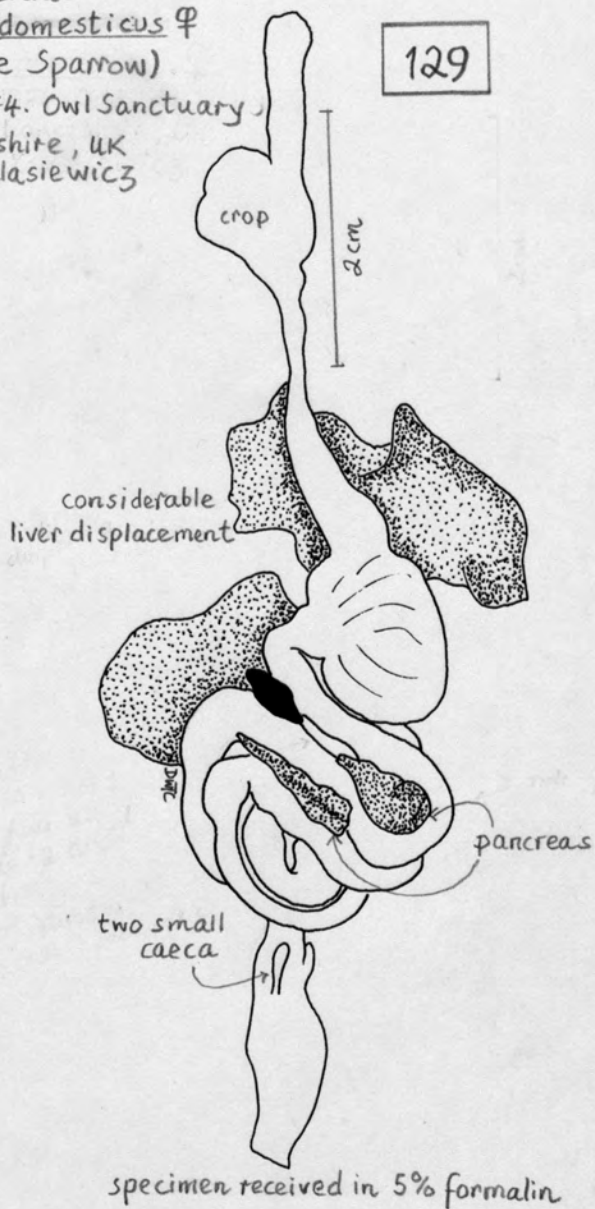
Mainly insectivorous feeding a wide variety of flying  
 insects; also snails, earthworms, spiders

128 *Piranga olivacea* (Scarlet Tanager)

129

Ploceidae:  
Passer domesticus ♀  
(House Sparrow)  
19th June 1974. Owl Sanctuary,  
Bury, Lancashire, UK  
Mrs Zalasiewicz

129



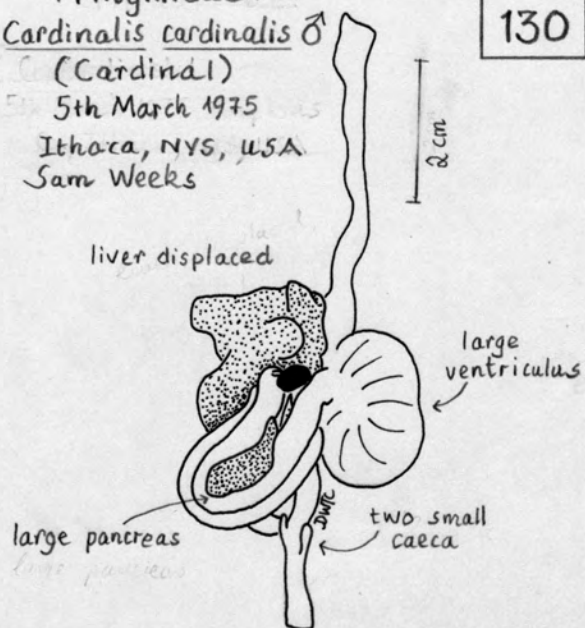
Feed mainly on seeds

129 *Passer domesticus* (House Sparrow)



Fringillidae:  
*Cardinalis cardinalis* ♂  
 (Cardinal)  
 5th March 1975  
 Ithaca, NYS, USA  
 Sam Weeks

130

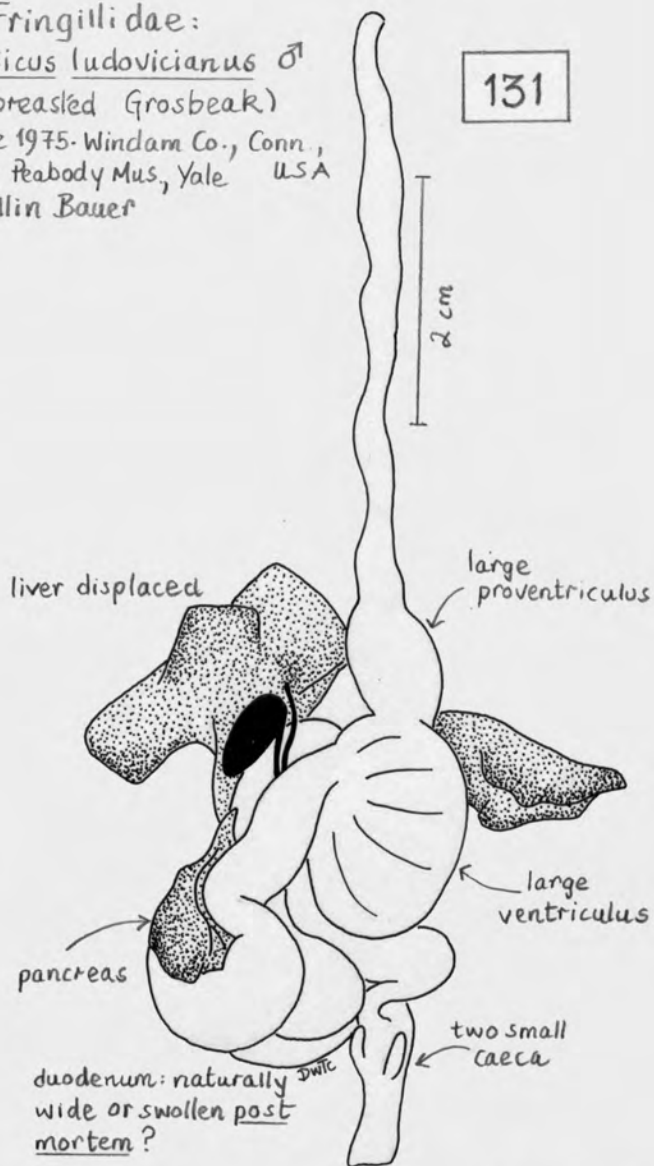


specimen received in 5% formalin  
 injured bird; euthanasia

Omnivorous, preference for seeds, insects, snails

Fringillidae:  
*Pheucticus ludovicianus* ♂  
 (Rose-breasted Grosbeak)  
 16th June 1975. Windham Co., Conn.,  
 S. Garber, Peabody Mus., Yale USA  
 Rollin Bauer

131



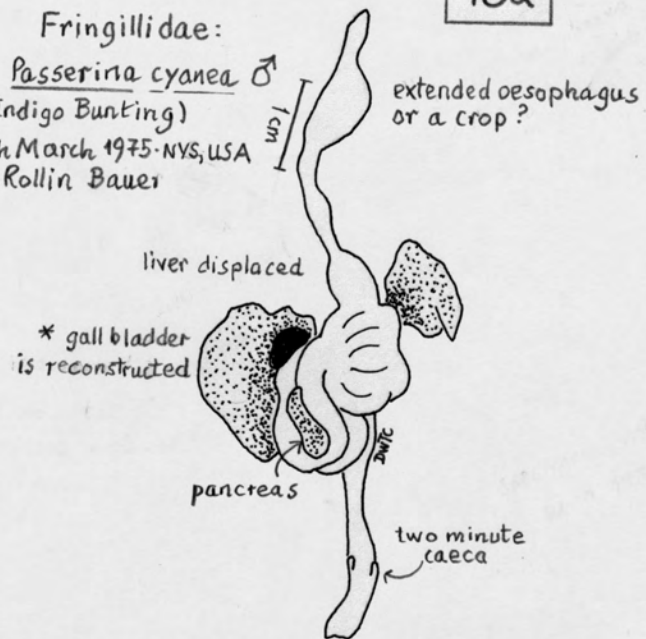
specimen received in 10% formalin  
 transferred to 5% formalin  
 18th July 1975

Feed on insects, seeds, berries



132

Fringillidae:  
*Passerina cyanea* ♂  
 (Indigo Bunting)  
 26th March 1975 - NVS, USA  
 Rollin Bauer



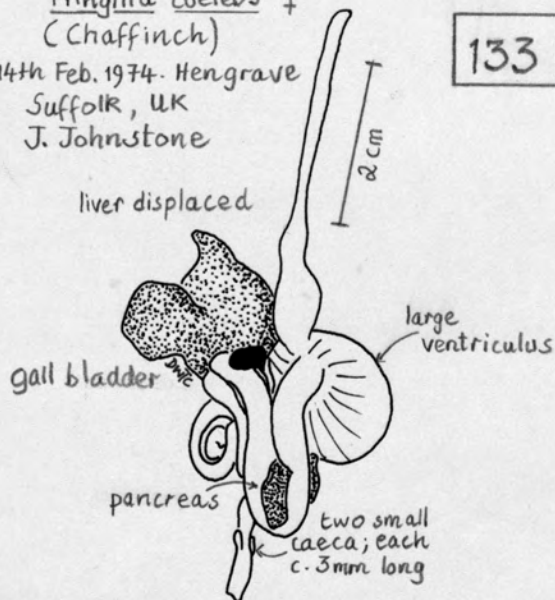
specimen received deep frozen  
 thawed in 5% formalin  
 [\* in a poor state of preservation.]

Omnivorous, seeds, buds, insects, spiders

132 *Passerina cyanea* (Indigo Bunting)

199  
Fringillidae:  
Fringilla coelebs ♀  
(Chaffinch)  
14th Feb. 1974. Hengrave  
Suffolk, UK  
J. Johnstone

133

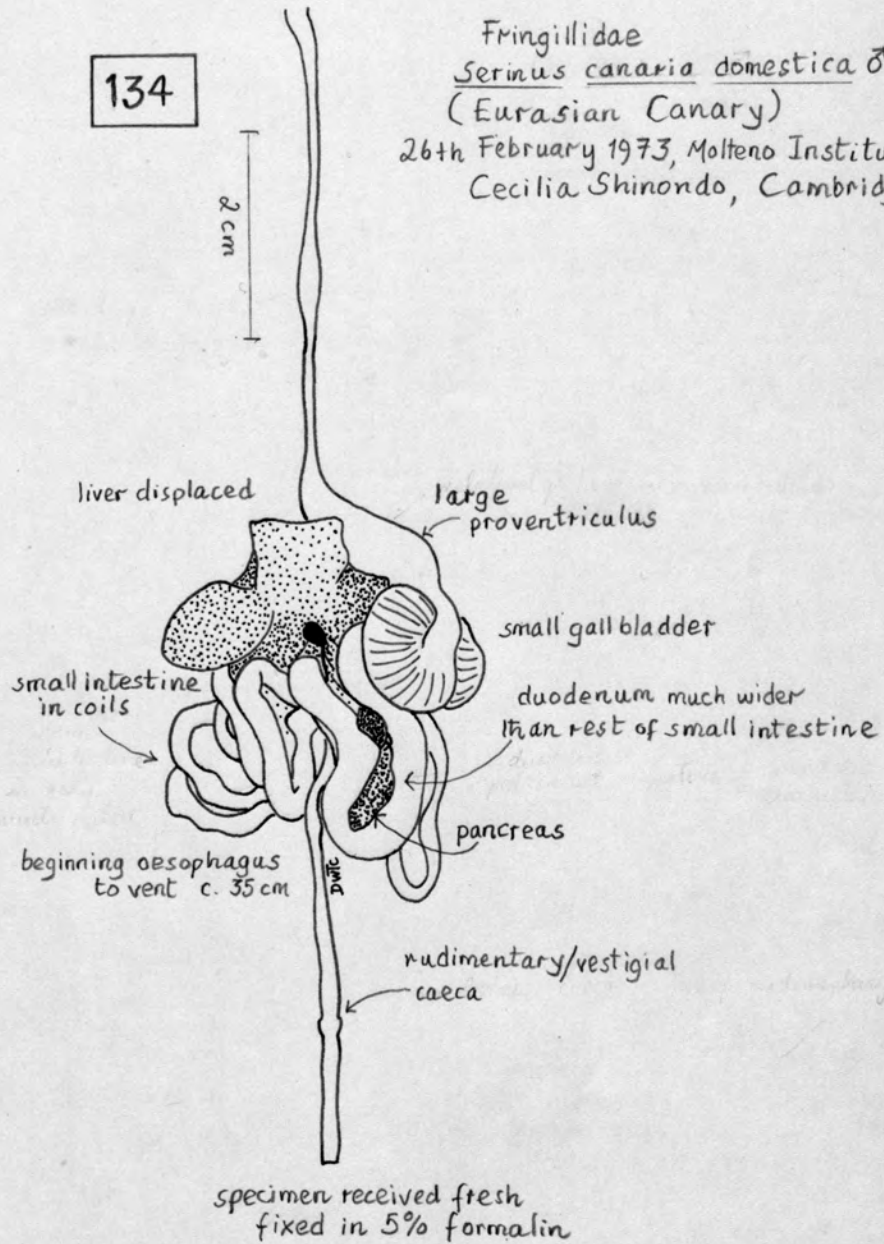


specimen fixed in 5% formalin

Feed on seeds, insects

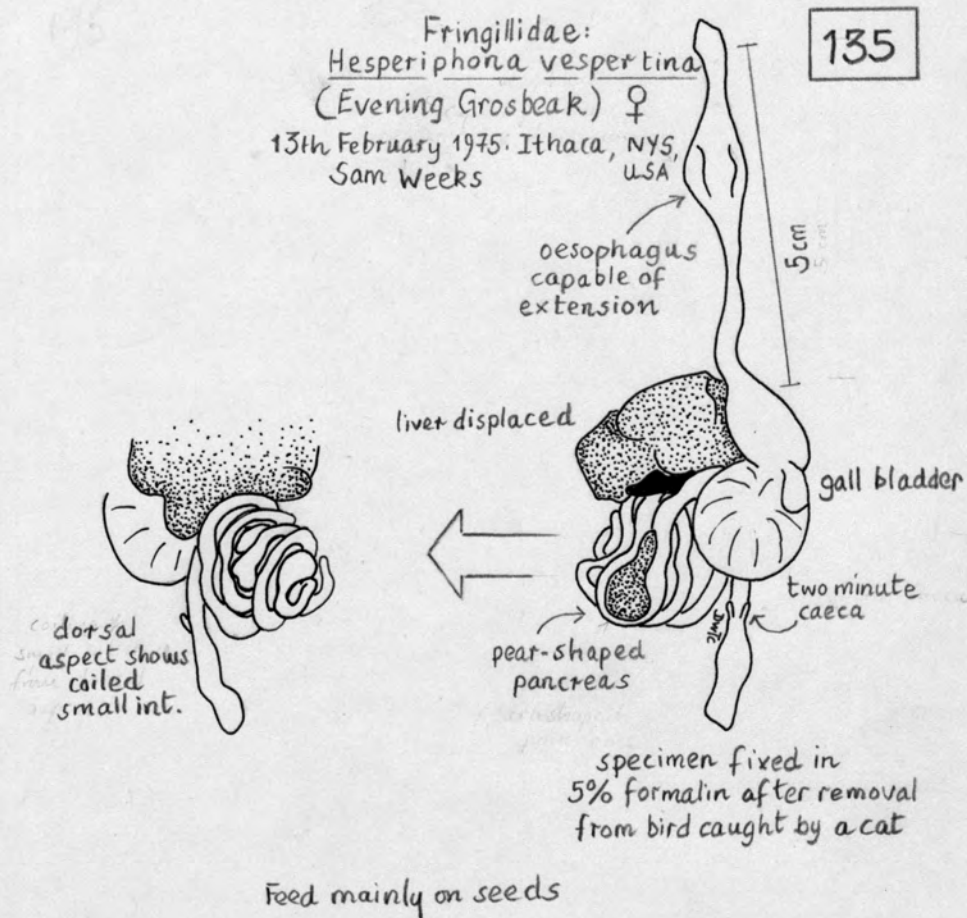
134

Fringillidae  
*Serinus canaria domestica* ♂  
 (Eurasian Canary)  
 26th February 1973, Molteno Institute,  
 Cecilia Shinondo, Cambridge, UK



Vegetarian: wild birds eat a variety of seeds and plant material

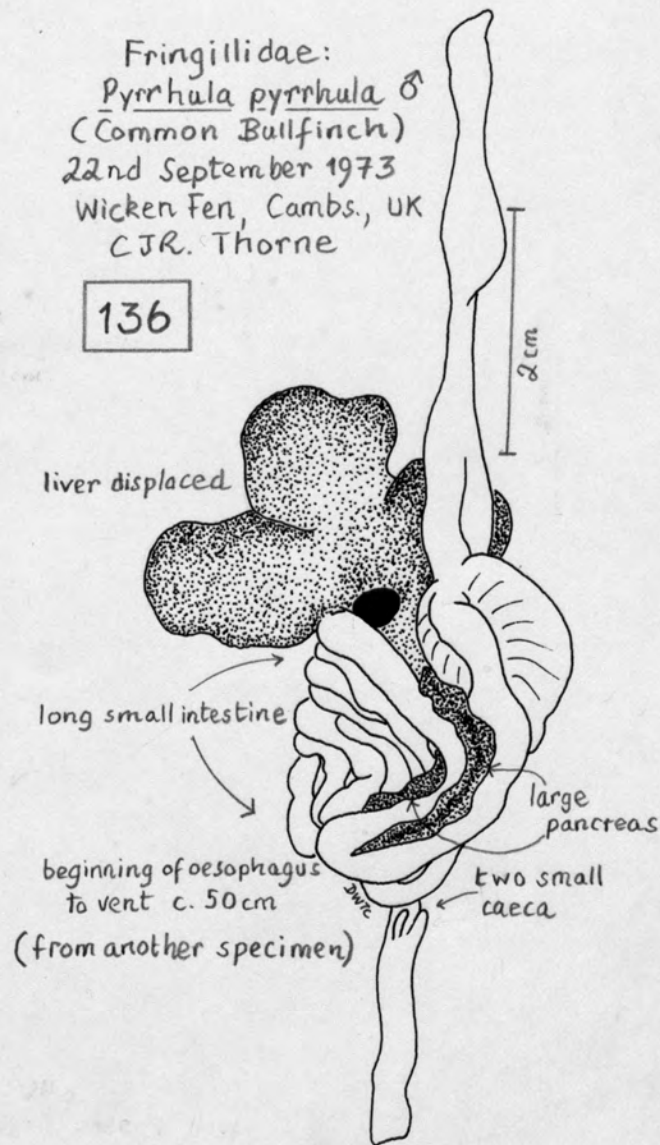
134 *Serinus canaria domestica* (Eurasian Canary)



135 *Hesperiphona vespertina* (Evening Grosbeak)

Fringillidae:  
*Pyrrhula pyrrhula* ♂  
 (Common Bullfinch)  
 22nd September 1973  
 Wicken Fen, Cambs., UK  
 C.J.R. Thorne

136



specimen fixed in 5% formalin

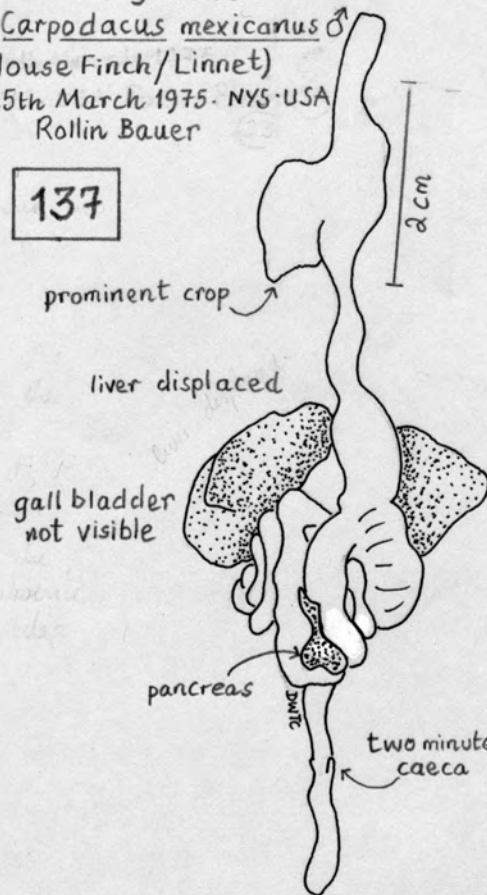
Feed on seeds, grains, buds

136 *Pyrrhula pyrrhula* (Common Bullfinch)



Fringillidae:  
*Carpodacus mexicanus* ♂  
 (House Finch/Linnet)  
 25th March 1975. NYS-USA  
 Rollin Bauer

137

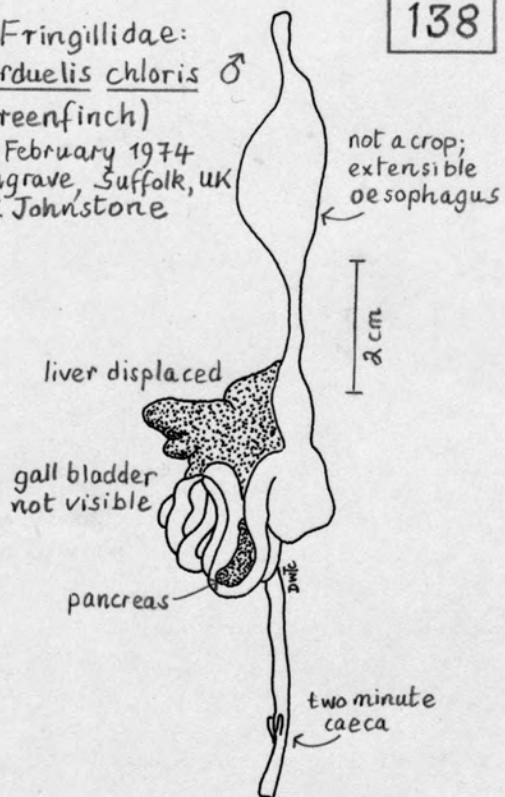


specimen received deep frozen  
 thawed in 5% formalin

Feed on seeds, grains, berries - small insects

138  
 Fringillidae:  
Carduelis chloris ♂  
 (Greenfinch)  
 14th February 1974  
 Hengrave, Suffolk, UK  
 J. Johnstone

138



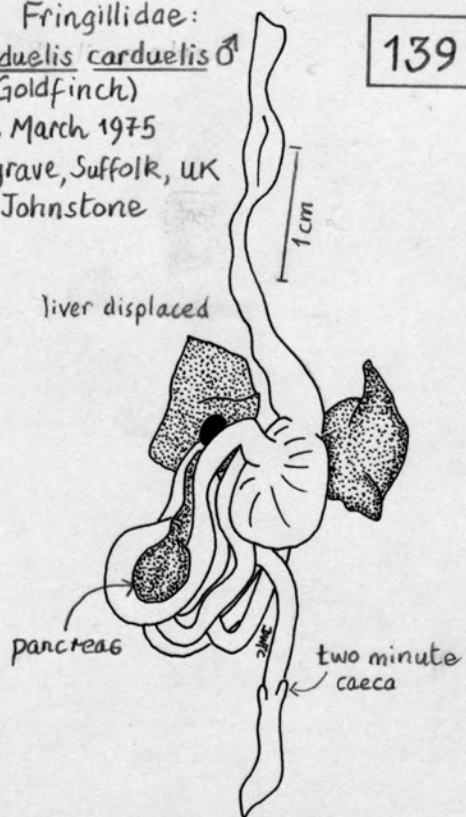
specimen received in 5% formalin

Feed on seeds, berries, insects



139  
Fringillidae:  
*Carduelis carduelis* ♂  
(Goldfinch)  
18th March 1975  
Hengrave, Suffolk, UK  
J. Johnstone

139

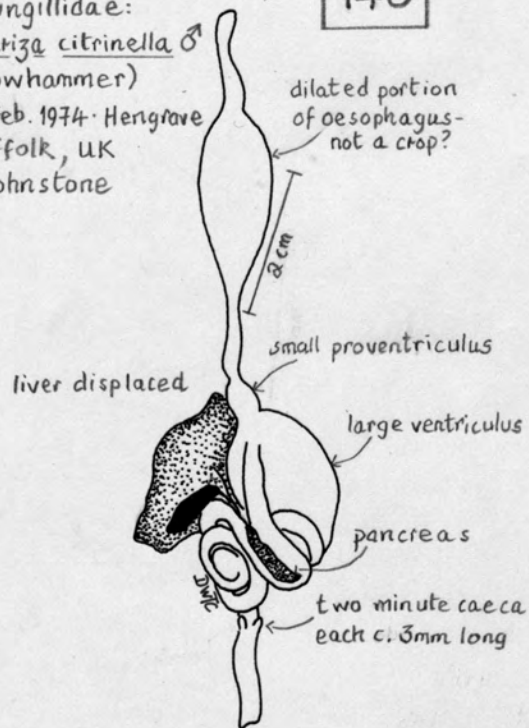


specimen received in 5% formalin  
20th October 1975

Feed on small seeds, insects

Fringillidae:  
*Emberiza citrinella* ♂  
 (Yellowhammer)  
 14th Feb. 1974 · Hengrave  
 Suffolk, UK  
 J. Johnstone

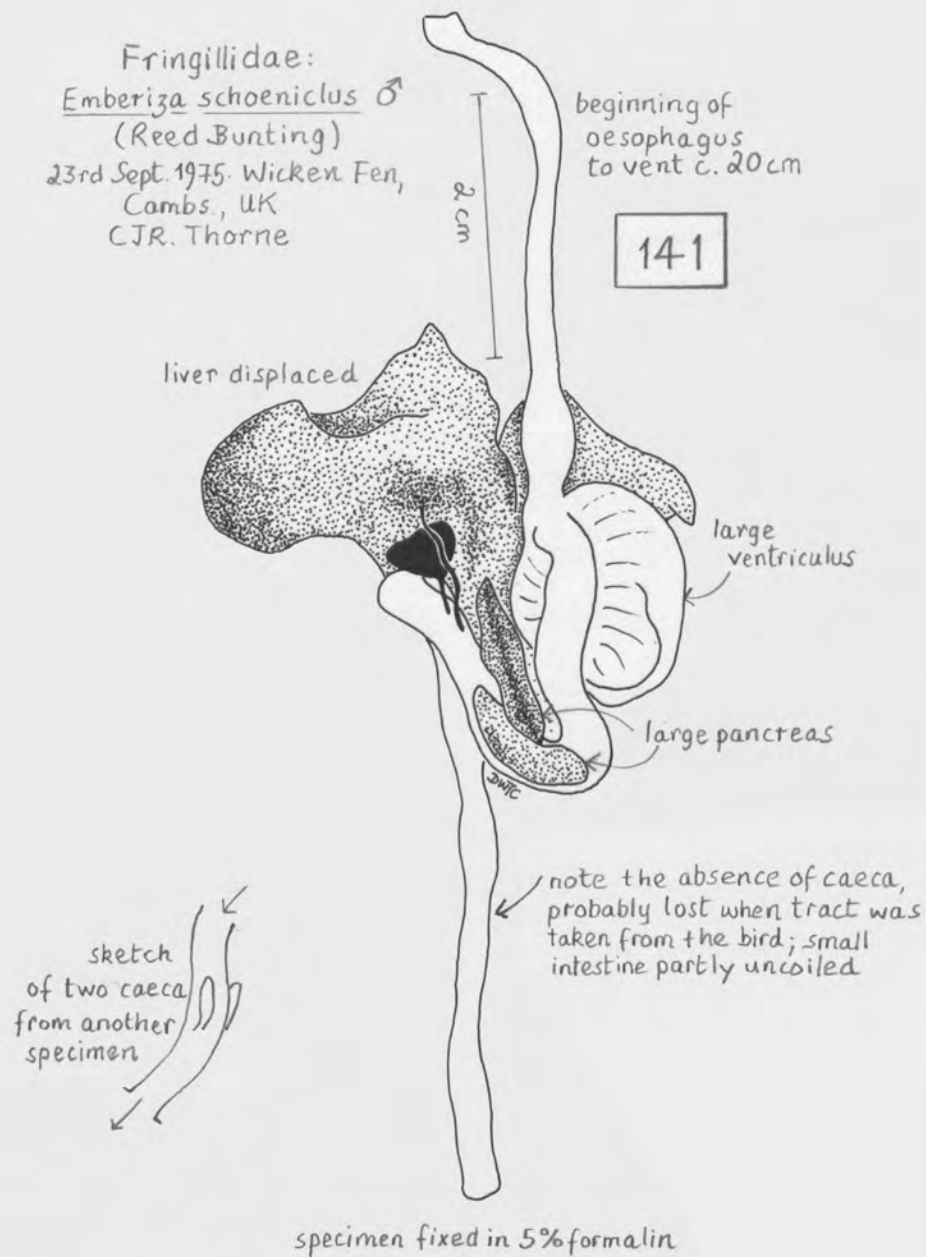
140



specimen fixed in 5% formalin

Forage on ground for seeds, take a variety of invertebrates

Fringillidae:  
*Emberiza schoeniclus* ♂  
 (Reed Bunting)  
 23rd Sept. 1975. Wicken Fen,  
 Cambs., UK  
 C.J.R. Thorne

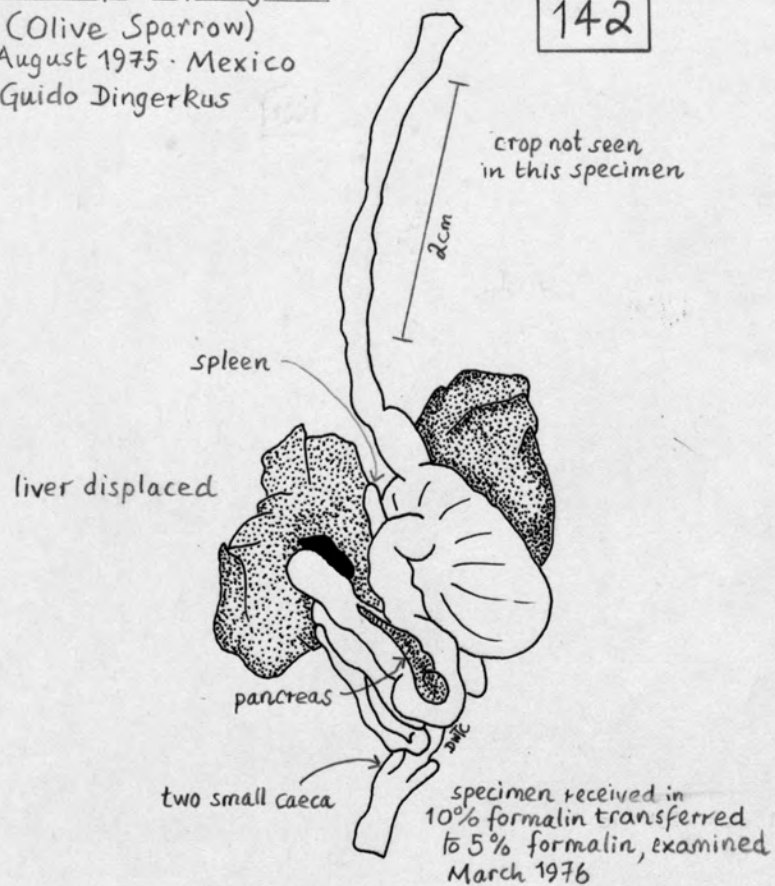


Feed on seeds and insects

141 *Emberiza schoeniclus* (Reed Bunting)

Fringillidae:  
Arremonops rufivirgatus ♂  
 (Olive Sparrow)  
 16th August 1975 · Mexico  
 Guido Dingerkus

142

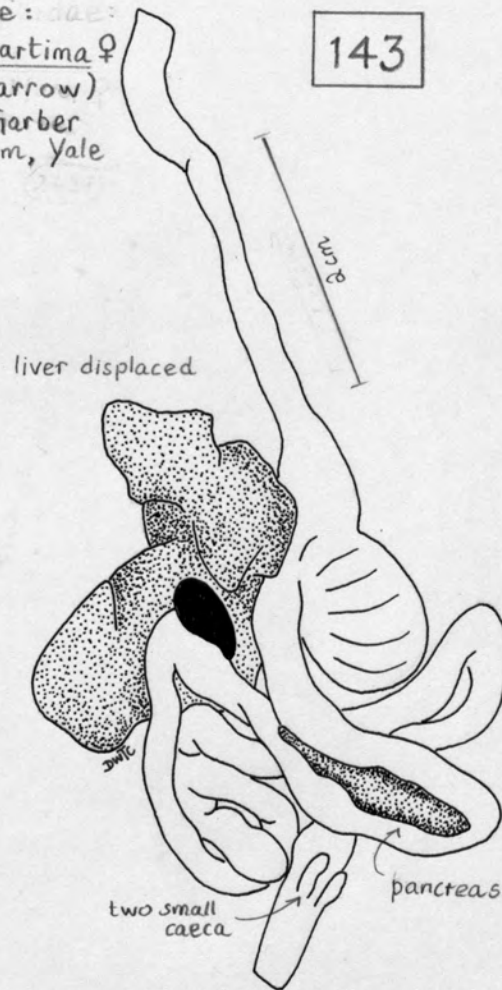


Diet of seeds, fruits, small insects

142 *Arremonops rufivirgatus* (Olive Sparrow)

Fringillidae: ~~male~~  
*Ammospiza maritima* ♀  
 (Seaside Sparrow)  
 Conn., USA. S Garber  
 Peabody Museum, Yale  
 Rollin Bauer

143



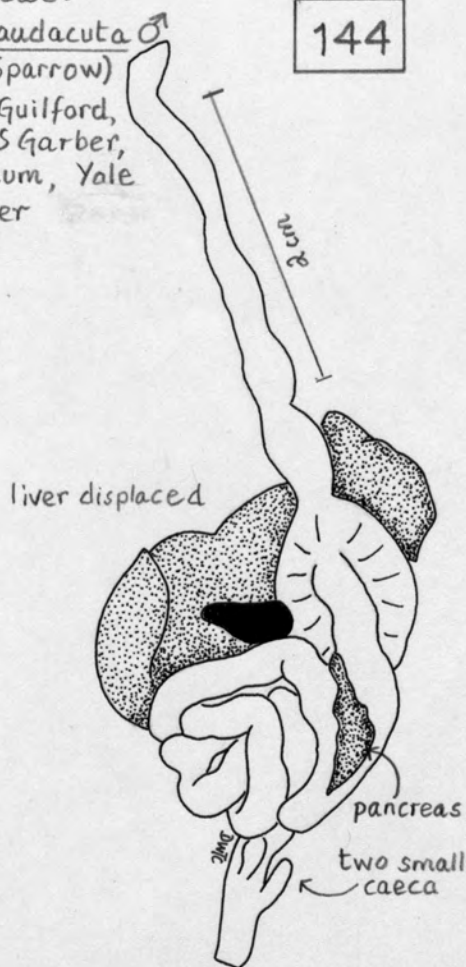
specimen received 18th July 1975 in  
 10% formalin transferred to 5% formalin

Omnivorous feeding on insects, marine invertebrates,  
 seeds



Fringillidae:  
*Ammospiza caudacuta* ♂  
 (\* Sharp-tailed Sparrow)  
 10th June 1975. Guilford,  
 Conn., USA. S Garber,  
 Peabody Museum, Yale  
 Rollin Bauer

144

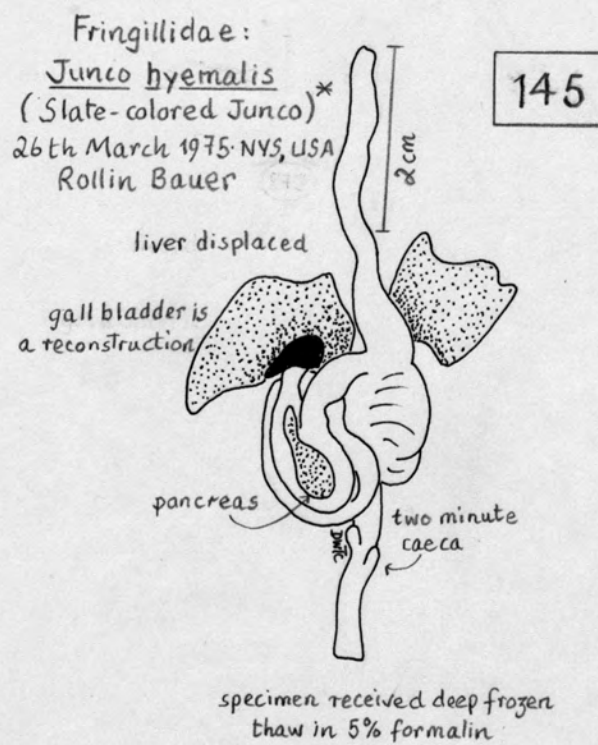


specimen received in 10% formalin  
 transferred to 5% formalin  
 examined 18th July 1975

\* Also known as the Saltmarsh Sharp-tail Sparrow

Omnivorous feeding on insects, spiders, marine  
 invertebrates, seeds

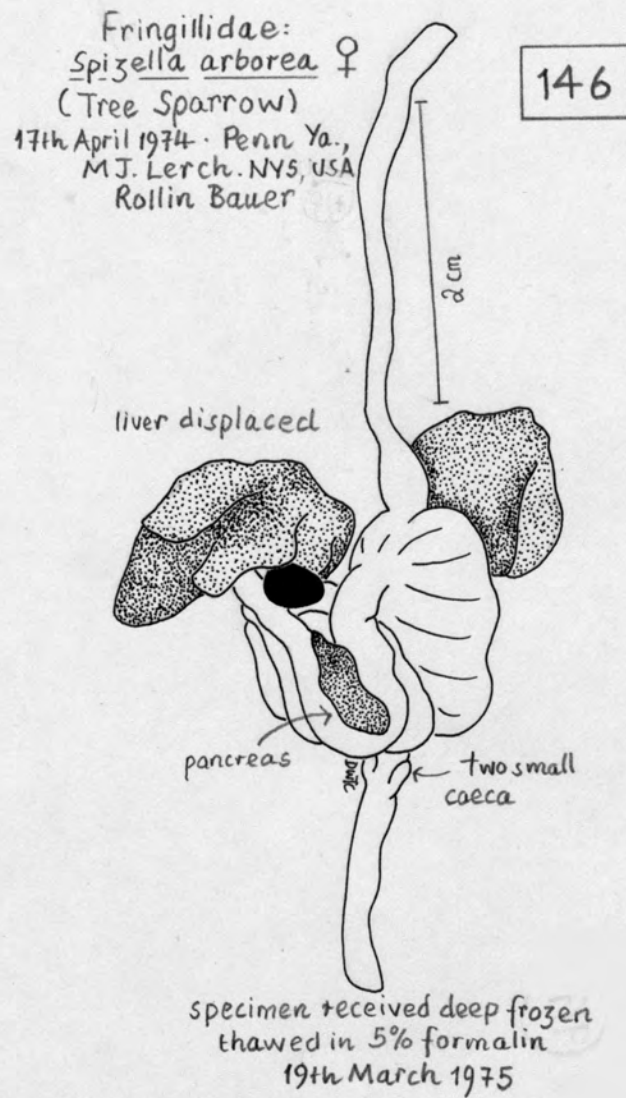
144 *Ammospiza caudacuta* (Sharp-tailed Sparrow)



Omnivorous; insects and seeds

\* listed by Clements (1974) as Dark-eyed Junco

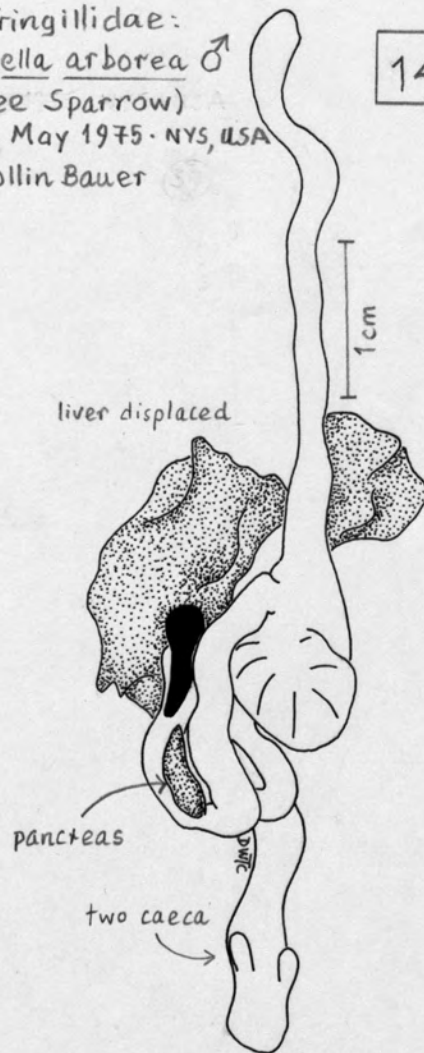




Feed on seeds, berries, insects

Fringillidae:  
Spizella arborea ♂  
(Tree Sparrow)  
14th May 1975 · NYS, USA  
Rollin Bauer

147



specimen received deep frozen  
thawed in 5% formalin

Diet mainly of seeds, some insects

147 *Spizella arborea* (Tree Sparrow)

Fringillidae:  
Zonotrichia leucophrys  
 (White-crowned Sparrow) ♀  
 13th May 1975. Tompkins Co.,  
 NYS, USA (bird hit by car)  
 Donna Kline

148

liver displaced

pancreas

two caeca

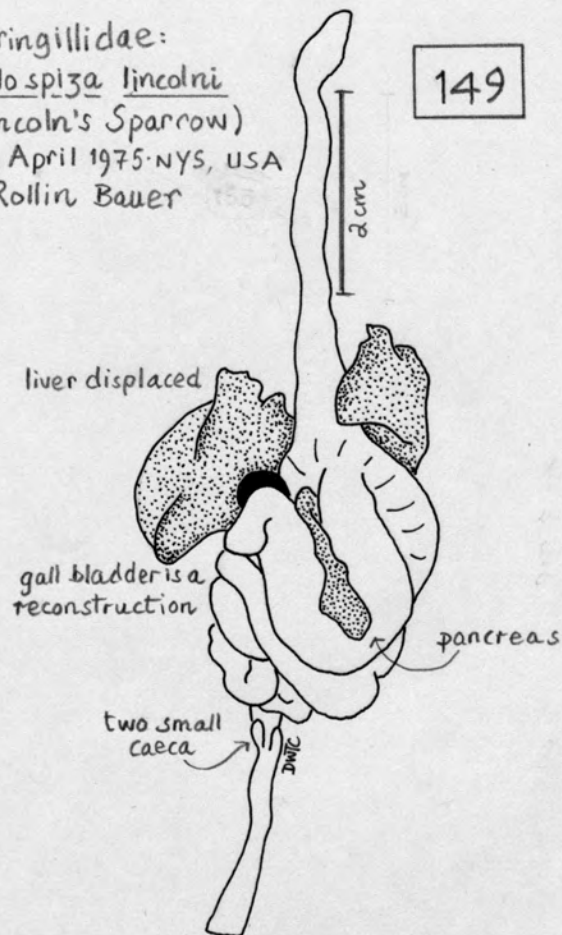
Diet mainly of seeds, some insects

specimen received deep frozen  
 thawed in 5% formalin

148 *Zonotrichia leucophrys* (White-crowned Sparrow)

Fringillidae:  
*Melospiza lincolni*  
 (Lincoln's Sparrow)  
 2nd April 1975-NYS, USA  
 Rollin Bauer

149

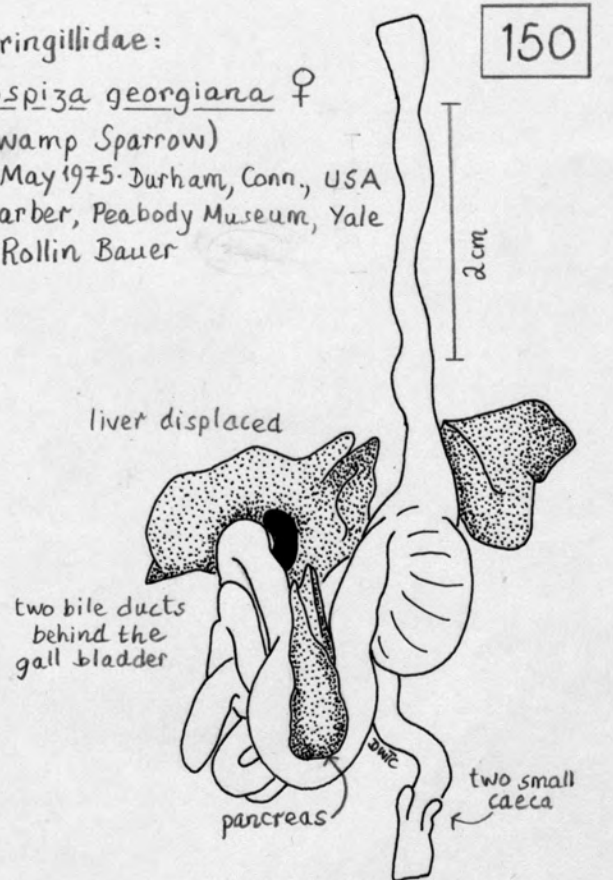


specimen received deep frozen  
 thawed in 5% formalin

Omnivorous feeding on insects, seeds

150

Fringillidae:  
Melospiza georgiana ♀  
 (Swamp Sparrow)  
 28th May 1975, Durham, Conn., USA  
 S. Garber, Peabody Museum, Yale  
 Rollin Bauer



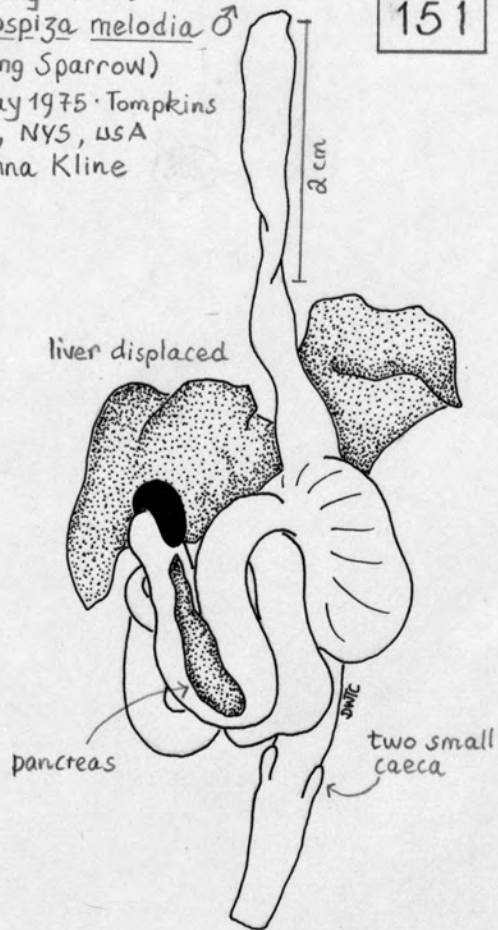
specimen received in 10% formalin  
 transferred to 5% formalin  
 18th July 1975

Omnivorous feeding on small arthropods,  
 fruits, berries



Fringillidae:  
*Melospiza melodia* ♂  
 (Song Sparrow)  
 6th May 1975 · Tompkins  
 Co., NYS, USA  
 Donna Kline

151



specimen received deep frozen  
 thawed in 5% formalin

Omnivorous ground feeders, insects, seeds

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